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MPLAB® IDE PICSTART® PLUS USER'S GUIDE

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Table of Contents

Preface 1

Chapter 1. PICSTART Plus Overview

1.1 Introduction 5
1.2 What is PICSTART Plus Programmer? 5
1.3 PICSTART Plus System Components 5
1.4 PICSTART Plus CE Compliance 6
1.5 How the PICSTART Plus Programmer Helps You 6
1.6 MPLAB Integrated Development Environment 7
1.7 MPLAB Development Tools 7

Chapter 2. PICSTART Plus Installation

2.1 Introduction 9
2.2 Host Computer System Requirements 9
2.3 Installing MPLAB IDE Software 9
2.4 Installing PICSTART Plus Hardware 10
2.5 Starting MPLAB IDE 11
2.6 Turning the PICSTART Plus On/Off 11
2.7 Selecting the Device 12
2.8 Selecting the PICSTART Plus Programmer 13
2.9 Configuring the Serial Port for PICSTART Plus 13
2.10 Enabling the PICSTART Plus 15

Chapter 3. Tutorial

3.1 Introduction 17
3.2 Before You Begin 17
3.3 Programming Overview 17
3.4 Selecting the Device 18
3.5 Creating the Project 19
3.6 Setting Up Language Tools 20
3.7 Naming the Project 21
3.8 Adding Files to the Project 22
3.9 Building the Initial Project 24
3.10 Creating Code 25
3.11 Building the Project 27
3.12 Enabling the PICSTART Plus 28
3.13 Programming the Device 29
3.14 Verifying the Programming 29
3.15 Tutorial Summary 29

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Chapter 4. Using the PICSTART Plus
4.1 Introduction 31
4.2 Preparation for Programming a Device 31
4.3 Procedure for Programming a Device 31
4.4 Verifying the Programming 46
4.5 Reading a Device 46
Chapter 5. PICSTART Plus – MPLAB IDE Reference
5.1 Introduction 49
5.2 PICSTART Plus Toolbar 49
5.3 Configure Menu 50
5.4 Debugger Menu 51
5.5 PICSTART Plus Programmer Menu 52
5.6 Programmer Settings 58
5.7 Files Used by the PICSTART Plus Programmer 61
5.8 Upgrading the PICSTART Plus Firmware OS 62
Appendix A. Hardware Specifications
A.1 Introduction 67
A.2 Connecting to a PC via the Serial Port 67
A.3 Physical Dimensions and Layout 67
Appendix B. Troubleshooting
B.1 Introduction 69
B.2 Common Problems 69
B.3 Error Messages, Warnings and Announcements 73
B.4 Limitations 76
Index 77
Worldwide Sales and Service 80

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB IDE on-line help. Select the Help menu, and then Topics to open a list of available on-line help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the PICSTART Plus device programmer. Items discussed in this chapter include:

- About This Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support

ABOUT THIS GUIDE

Document Layout

This document describes how to use PICSTART Plus as a development tool to program firmware to a target device. The manual layout is as follows:

- **Chapter 1: PICSTART Plus Overview** – Describes the PICSTART Plus and how it works.
- **Chapter 2: PICSTART Plus Installation** – How to install PICSTART Plus hardware and MPLAB software.
- **Chapter 3: Tutorial** – Contains tutorials for programming calibration memory devices, memory devices and other PICmicro MCU devices.
- **Chapter 4: Using the PICSTART Plus** – How to use PICSTART Plus to program devices.
- **Chapter 5: PICSTART Plus – MPLAB IDE Reference** – PICSTART Plus options available through the PICSTART Plus menu and Options menu.

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- **Appendix A: "Hardware Specifications"** – Provides information on the 25-pin serial port, changing voltages and programmer dimensions.
- **Appendix B: Troubleshooting** – How to solve common problems.

Conventions Used in this Guide

This User's Guide uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
'b*nnnn*	A binary number where *n* is a digit	'b00100, 'b10
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier font:		
Plain Courier	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
Italic Courier	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
`0x`*`nnnn`*	A hexadecimal number where *`n`* is a hexadecimal digit	`0xFFFF, 0x007A`
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

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RECOMMENDED READING

This user's guide describes how to use MPLAB PICSTART Plus programmer. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

README for PICSTART Plus

For the latest information on using the PICSTART Plus, read the `Readme for PICSTART Plus.txt` file (an ASCII text file) in the Readmes subdirectory of the MPLAB IDE installation directory. The Readme file contains update information and known issues that may not be included in this user's guide.

PICSTART Plus On-line Help

MPLAB IDE V6.XX Quick Start Guide (DS51281)

Describes how to set up the MPLAB IDE software and use it to create projects and program devices.

MPASM™ User's Guide with MPLINK™ Linker and MPLIB™ Librarian (DS33014)

This user's guide describes how to use the Microchip PICmicro® MCU MPASM assembler, the MPLINK object linker and the MPLIB object librarian.

MPLAB IDE On-line Help

In-Circuit Serial Programming™ (ICSP™) Guide (DS30277)

This document contains helpful design guidelines to follow for successful ICSP programming. It includes application notes on hardware designs and the ICSP programming specifications.

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- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

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To register, access the Microchip web site at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers and other language tools. These include the MPLAB C17, MPLAB C18 and MPLAB C30 C compilers; MPASM™ and MPLAB ASM30 assemblers; MPLINK™ and MPLAB LINK30 object linkers; and MPLIB™ and MPLAB LIB30 object librarians.
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB ICE 2000 and MPLAB ICE 4000.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debugger, MPLAB ICD 2.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows® Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE and MPLAB SIM simulators, MPLAB IDE Project Manager and general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include the MPLAB PM3 and PRO MATE® II device programmers and the PICSTART® Plus development programmer.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://support.microchip.com

In addition, there is a Development Systems Information Line which lists the latest versions of Microchip's development systems software products. This line also provides information on how customers can receive currently available upgrade kits.

The Development Systems Information Line numbers are:

1-800-755-2345 – United States and most of Canada

1-480-792-7302 – Other International Locations

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Chapter 1. PICSTART Plus Overview

1.1 INTRODUCTION

This chapter presents an overview of the features and requirements of the PICSTART Plus development programmer. Topics covered in this chapter include:

- What is PICSTART Plus Programmer?
- PICSTART Plus System Components
- PICSTART Plus CE Compliance
- How the PICSTART Plus Programmer Helps You?

1.2 WHAT IS PICSTART PLUS PROGRAMMER?

The PICSTART Plus is a Microchip microcontroller development programmer that enables you to program user software into PICmicro microcontroller devices. Devices in non-DIP packages that are supported by the PICSTART Plus require the use of an adapter. Those currently available are listed on the Microchip web site.

Note: The PICSTART Plus programmer is designed for use in firmware development and is not intended for production use.

1.3 PICSTART PLUS SYSTEM COMPONENTS

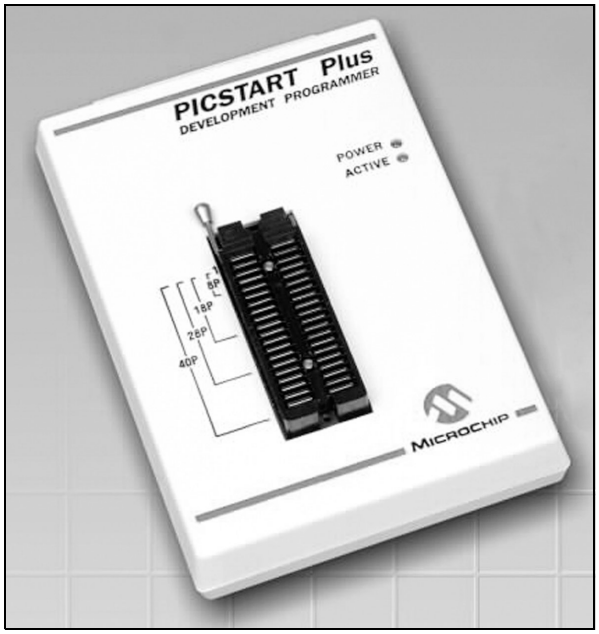
The PICSTART Plus development programmer system includes:

- PICSTART Plus development programmer (Figure 1-1)
- RS-232 Interface cable to connect to any standard PC serial port
- 9V power supply
- MPLAB IDE software - an Integrated Development Environment as detailed in **Section 1.7 "MPLAB Development Tools"**
- Blank chip for programming

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FIGURE 1-1: PICSTART PLUS DEVELOPMENT PROGRAMMER



1.4 PICSTART PLUS CE COMPLIANCE

The PICSTART Plus development system is designed, tested and certified to meet the Electromagnetic Compatibility requirements known as the CE compliance directives. These standards set by the European Union (EU) countries include limiting radiated emission, reducing susceptibility to radiated emission and reducing susceptibility to Electrostatic Discharge (ESD).

1.5 HOW THE PICSTART PLUS PROGRAMMER HELPS YOU

The PICSTART Plus development programmer has the following features:

- Programs PICmicro microcontrollers, including program memory, configuration bits and ID locations
- Operates as a Windows® application on a PC-compatible host system within the MPLAB Integrated Development Environment (IDE)
- Communicates with the PC via a standard RS-232 cable
- With MPLAB IDE, the user can create, display and edit data to be programmed into PICmicro microcontrollers (MCUs)

  In addition, you can verify that PICmicro MCUs are blank, verify that code in the target microcontroller matches your firmware and you can read code from an unprotected PICmicro MCU into the MPLAB IDE program memory window for debugging and programming into other PICmicro MCU devices.

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1.6 MPLAB INTEGRATED DEVELOPMENT ENVIRONMENT

The MPLAB desktop provides an environment for developing and debugging your application. PICSTART Plus is integrated into the MPLAB IDE.

This document covers the basic setup and operation of the PICSTART Plus device programmer, but it does not cover all functions of the MPLAB IDE. Read the MPLAB IDE documentation to get a full understanding of the features and debug capabilities of the MPLAB IDE.

1.7 MPLAB DEVELOPMENT TOOLS

The MPLAB IDE integrates several tools to provide a complete development environment.

- **MPLAB Project Manager**

  The Project Manager is used to create a project and work with the specific files related to the project. When using a project, source code is rebuilt and downloaded to the simulator or emulator with a single mouse click.
- **MPLAB Editor**

  The MPLAB Editor is used to create and edit text files such as source files, code and linker script files.
- **MPLAB SIM Simulator**

  The software simulator models the instruction execution and I/O of the PICmicro MCUs.
- **MPLAB ICD 2**

  Microchip's In-Circuit Debugger that works with MPLAB IDE for PIC18FXXX devices.
- **MPLAB ICE Emulator**

  The MPLAB ICE emulator uses hardware to emulate PICmicro MCUs in real time, either with or without a target system.
- **MPASM Universal Assembler/MPLINK Relocatable Linker/MPLIB Librarian**

  The MPASM assembler allows source code to be assembled without leaving the MPLAB IDE. MPLINK creates the final application by linking relocatable modules from MPASM, MPLAB C17 and MPLAB C18. MPLIB manages custom libraries for maximum code reuse.
- **MPLAB C17, MPLAB C18 and C30 C Compilers**

  The MPLAB C17, MPLAB C18 and MPLAB C30 C Compilers provide ANSI-based high level source code solutions. Complex projects can use a combination of C and assembly source files to obtain the maximum benefits of speed and maintainability.
- **MPLAB PM3, PRO MATE II, PICSTART Plus and PICkit™ Programmers**

  Develop code with the simulator or an emulator, assemble or compile it, then use one of these tools to program devices. This can all be accomplished with the MPLAB IDE.
- **Third Party Tools**

  Many other companies have development tools for Microchip products that work with the MPLAB IDE. Consult the Microchip web site for additional information.

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NOTES:

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Chapter 2. PICSTART Plus Installation

2.1 INTRODUCTION

The PICSTART Plus development system requires connecting the hardware to the PC and the installation of the MPLAB IDE software.

This chapter covers:

- Host Computer System Requirements
- Installing MPLAB IDE Software
- Installing PICSTART Plus Hardware
- Starting MPLAB IDE
- Turning the PICSTART Plus On/Off
- Selecting the Device
- Selecting the PICSTART Plus Programmer
- Configuring the Serial Port for PICSTART Plus
- Enabling the PICSTART Plus

2.2 HOST COMPUTER SYSTEM REQUIREMENTS

The following minimum configuration is required to run the MPLAB IDE:

- PC-compatible Intel Pentium® class system
- Microsoft Windows® 98 SE, Windows ME, Windows XP, Windows NT® 4.0 SP6a Workstations (NOT Servers), or Windows 2000 SP2 Windows
- 32 MB memory (128 MB recommended)
- 85 MB of hard disk space
- Internet Explorer 5.0 or greater for installation and on-line Help
- One serial port

2.3 INSTALLING MPLAB IDE SOFTWARE

Install the MPLAB IDE software by following the instructions in the MPLAB IDE documentation. Refer to the MPLAB IDE documentation for more detailed instructions.

- Insert the MPLAB IDE CD-ROM into your CD-ROM drive (Example: drive D). The CD will automatically begin the setup.
- Follow the on-screen instructions to install the MPLAB IDE.

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2.4 INSTALLING PICSTART PLUS HARDWARE

The PICSTART Plus hardware is simple to set up. First, the communications cable is attached, and then the power supply is connected.

2.4.1 Installing the Communications Cable

PICSTART Plus provides communications with the host PC via an RS-232 9-pin, D type connector. PICSTART Plus is Data Communication Equipment (DCE), and hardware handshaking is via Clear-To-Send (CTS) and Request-To-Send (RTS).

A 6-foot data cable with DB-9 connectors is supplied with PICSTART Plus. All lines on the data cable are wired straight through. This cable is NOT a null modem cable.

To install the serial communications cable:

1. Connect one end of the cable to an available COM port on your PC. Check your PC setup to see which communications port is available.
2. Connect the cable from your COM port to the PICSTART Plus development programmer.

2.4.2 Installing the Power Supply

The PICSTART Plus comes with a 9V input power supply. PICSTART Plus requires +9 volts ±10% at 500 mA (max.) on the center positive 2.5 mm terminal.

To install the power supply:

1. Plug the power cable attached to the power supply into a power outlet.
2. Connect the thin power supply cable to the PICSTART Plus. This supplies power to the PICSTART Plus programmer. The green power light will come on.

WARNING

DO NOT connect power with a device in the socket. Damage to the device may result.

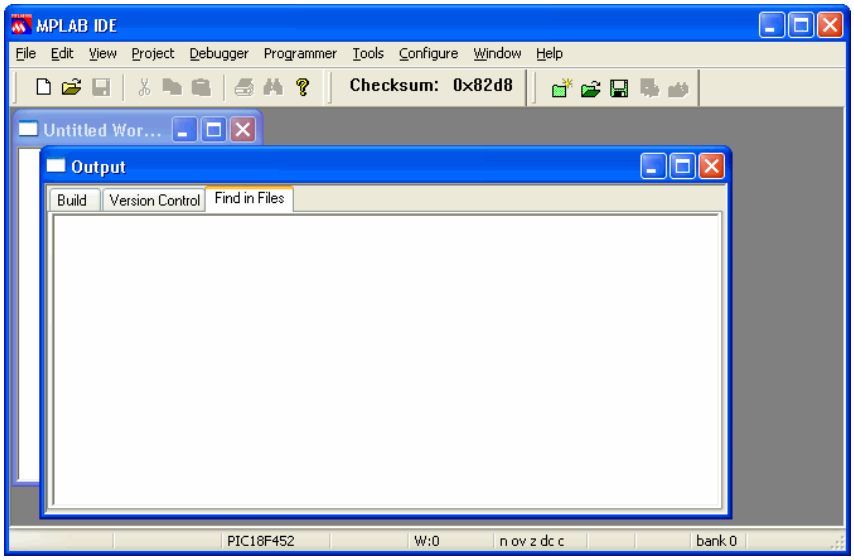
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2.5 STARTING MPLAB IDE

To start the MPLAB IDE, double click on the icon installed on the desktop after installation or select *Start>Programs>Microchip MPLAB IDE>MPLAB IDE*. A screen will display the MPLAB IDE logo followed by the MPLAB IDE desktop. The MPLAB IDE desktop should look similar to Figure 2-1.

FIGURE 2-1: MPLAB IDE DESKTOP



2.6 TURNING THE PICSTART PLUS ON/OFF

Simply plug in or unplug the PICSTART Plus power supply to turn the programmer on or off, respectively.

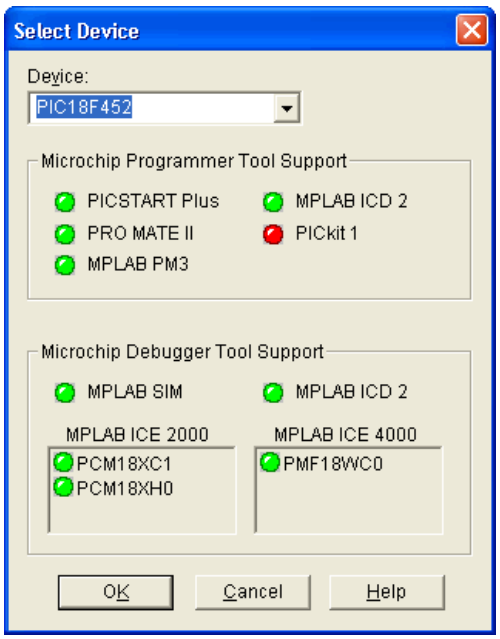
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2.7 SELECTING THE DEVICE

Select *Configure>Select Device* to select a device from the list of available devices (see Figure 2-2). When you select a device, indicators next to the Microchip Tools names show the level of support for that device: green - supports the device, yellow - limited support and red - no support. If the selected device is supported by PICSTART Plus, click **OK**.

If you select a device that is incompatible with PICSTART Plus, a warning displays stating PICSTART Plus does not support that device.

FIGURE 2-2: SELECT DEVICE DIALOG



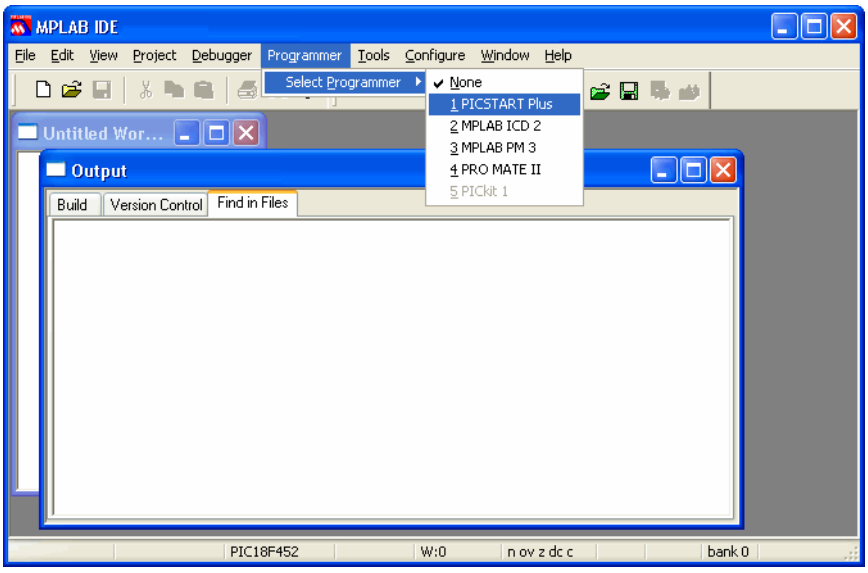
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2.8 SELECTING THE PICSTART PLUS PROGRAMMER

Select *Programmer>Select Programmer>PICSTART Plus* from the MPLAB IDE menu to select the programmer (Figure 2-3). Once the programmer is selected, PICSTART Plus appears at the bottom of the screen.

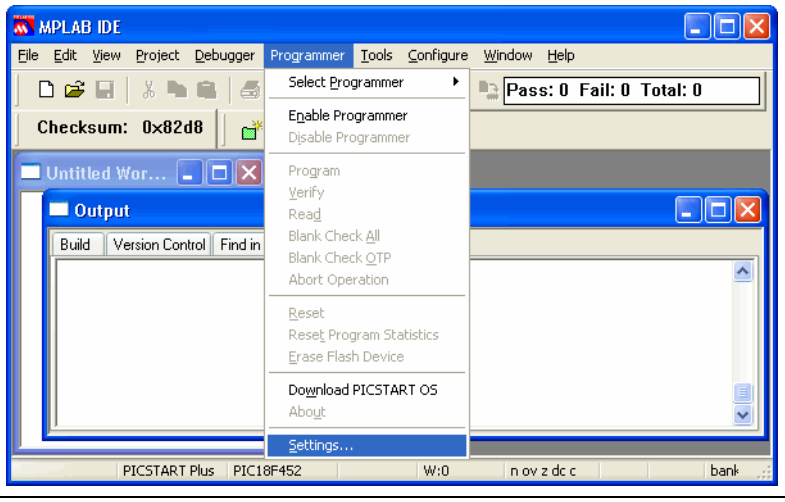
FIGURE 2-3: SELECT PROGRAMMER



2.9 CONFIGURING THE SERIAL PORT FOR PICSTART PLUS

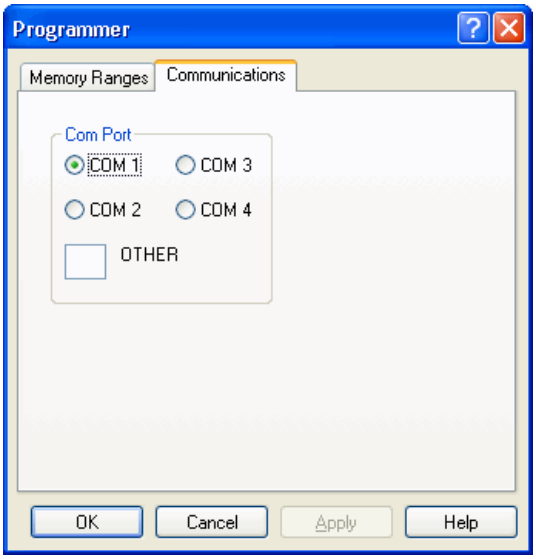
To configure the serial port for the PICSTART Plus, select *Programmer> Settings* (Figure 2-4) and click on the **Communications** tab. A dialog similar to the one shown in Figure 2-5 will appear.

FIGURE 2-4: PROGRAMMER SETTINGS



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FIGURE 2-5: COMMUNICATIONS PORT SETUP DIALOG



The **Communications** tab shows the possible PC serial communication ports. Select the COM port used for the PICSTART Plus. If a COM port number between 4 and 255 has been configured for use on the workstation, type the number in the "Other" text box. Click **OK** to set the COM port or click **Cancel** if you want to close the dialog without selecting a COM port.

Note: The programmer uses COM 1 as the default serial port. If you change your serial port selection, then the next time you run your programmer, the host software will use the same serial port used in the previous session.

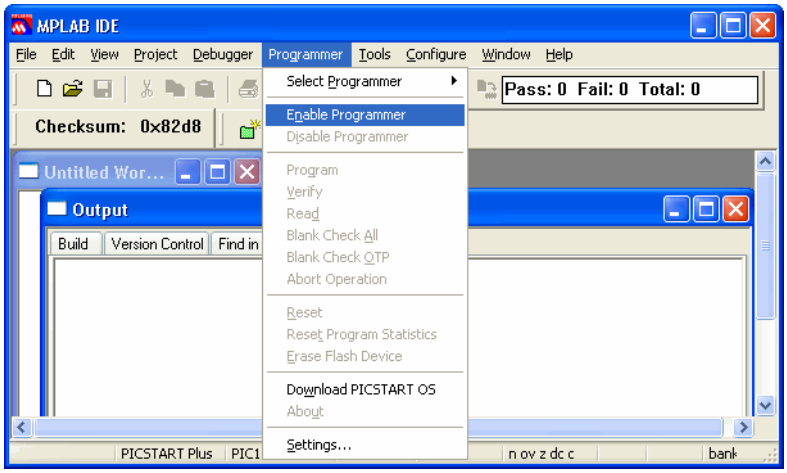
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2.10 ENABLING THE PICSTART PLUS

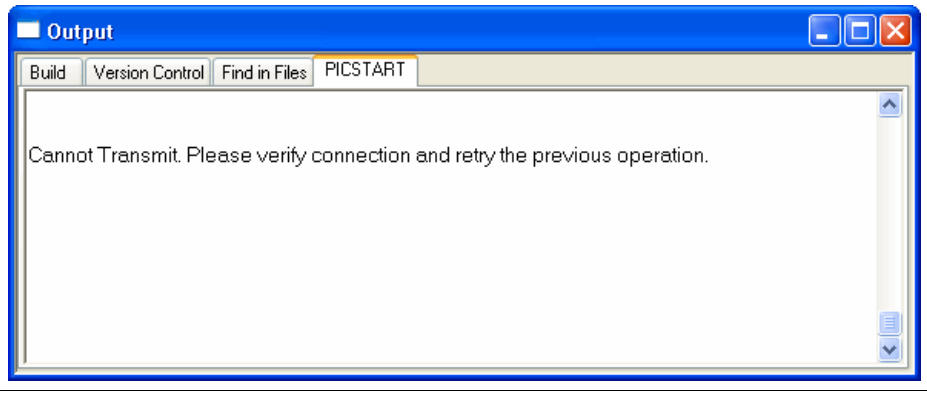
You should select a device that is supported by the firmware in use before enabling the programmer. Select *Configure>Select Device* and choose a device supported by the PICSTART Plus. To check that the PC and the programmer are communicating properly, select *Programmer>Enable Programmer* (see Figure 2-6) enable the PICSTART Plus programmer.

FIGURE 2-6: ENABLING THE PICSTART PLUS



If PICSTART Plus is not found on the selected COM port, a dialog similar to Figure 2-7 appears.

FIGURE 2-7: COMMUNICATIONS ERROR DIALOG



If you cannot establish communications between the PC and PICSTART Plus, make sure you have installed the hardware and software correctly (see **Section 2.4 "Installing PICSTART Plus Hardware"** and **Section 2.3 "Installing MPLAB IDE Software"**). If you still cannot establish communications between the PC and PICSTART Plus, please see **Appendix B. "Troubleshooting"**.

If you have been using another programmer (e.g., PRO MATE II) with a device that is not supported by the PICSTART Plus, the PICSTART Plus programmer menu might not be available. Ensure that the device currently selected is supported by the PICSTART Plus and the firmware in use (see **Section 2.7 "Selecting the Device"**). Select *Programmer>Select Programmer* and choose PICSTART Plus from the list, then select *Programmer>Enable Programmer* to enable the PICSTART Plus.

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Chapter 3. Tutorial

3.1 INTRODUCTION

The tutorial in this chapter leads you through the steps involved in programming the PIC18F452 PICmicro device using MPLAB IDE Project Wizard.

3.2 BEFORE YOU BEGIN

Before you can begin this tutorial, you must:

1. Install the MPLAB IDE software. See **Section 2.3 "Installing MPLAB IDE Software"**.
2. Install the PICSTART Plus hardware. See **Section 2.4 "Installing PICSTART Plus Hardware"**.
3. Make sure you have read and completed all the instructions in **Section 2.6 "Turning the PICSTART Plus On/Off"** and **Section 2.9 "Configuring the Serial Port for PICSTART Plus"**.
4. Make sure that your PC and PICSTART Plus are communicating and the PICSTART Plus menu appears on the MPLAB menu before you begin this tutorial.

3.3 PROGRAMMING OVERVIEW

Programming a mid-range PICmicro device involves the following steps:

- Selecting the Device
- Creating the Project
- Setting Up Language Tools
- Naming the Project
- Adding Files to the Project
- Building the Initial Project
- Creating Code
- Building the Project
- Enabling the PICSTART Plus
- Programming the Device
- Verifying the Programming

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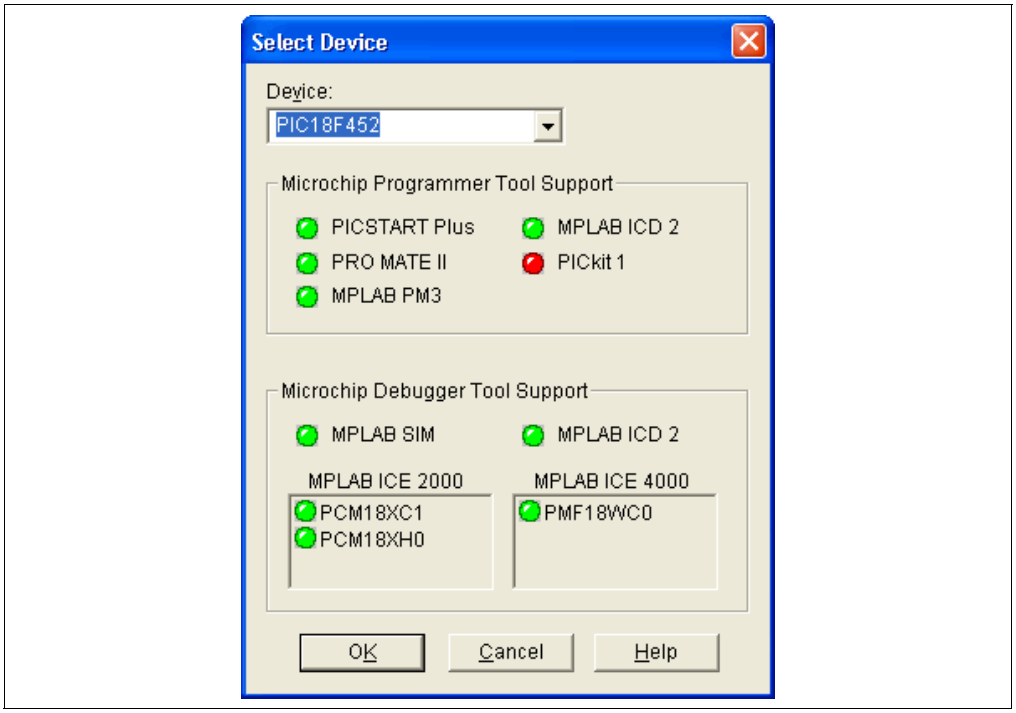
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3.4 SELECTING THE DEVICE

If you have not already selected the device in MPLAB IDE, do so by selecting *Configure>Select Device* to open the Select Device dialog (Figure 3-1) and select the PIC18F452 device.

Under Microchip Programmer Tool Support, verify that this device is supported (green light) by the PICSTART Plus. Click **OK**.

FIGURE 3-1: SELECTING THE DEVICE



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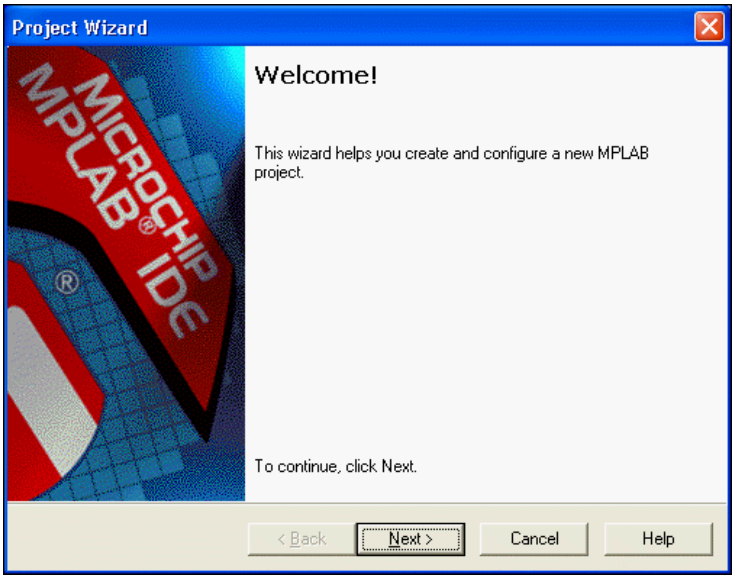
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3.5 CREATING THE PROJECT

In order to program the device, you'll need a hex file. In this example, we'll create a project to generate the hex file using the Project Wizard. We will use a single assembly file for this project and a linker script. Choose the *Project>Project Wizard* to begin using the Project Wizard and display the Welcome screen (Figure 3-2).

Note: Before using the Project Wizard, check that the option to associate the project with the workspace is enabled. Select *Configure>Settings*, then click on the **Projects** tab. Select the check box for "Use one-to-one project-workspace model" and click **OK**.

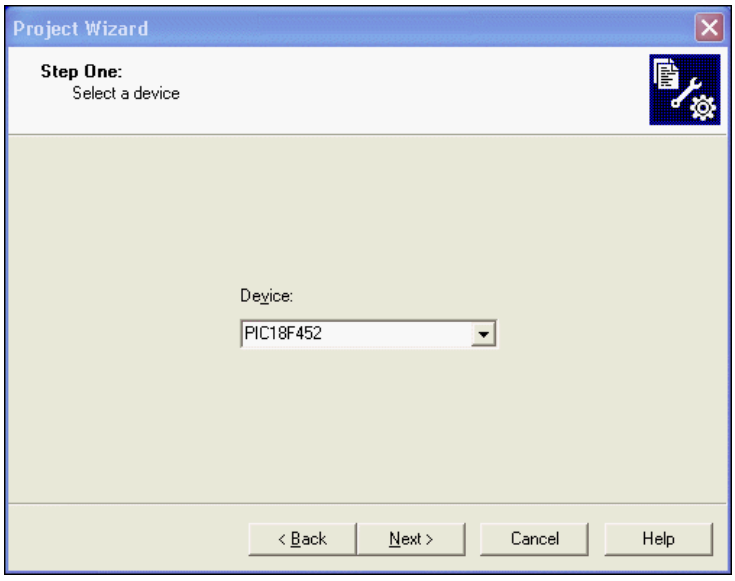
FIGURE 3-2: PROJECT WIZARD WELCOME SCREEN



Click on **Next>** to advance to the next dialog in the Project Wizard.

This dialog (Figure 3-3) allows you to select the device, which we've already done. Make sure "PIC18F452" is selected. Otherwise, select the PIC18F452 device. Click **Next>**.

FIGURE 3-3: PROJECT WIZARD - SELECT DEVICE



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3.6 SETTING UP LANGUAGE TOOLS

In Step Two of the Project Wizard, select "Microchip MPASM Toolsuite" in the Active Toolsuite list box. Then you should see "MPASM" and "MPLINK" show up in the Toolsuite Contents box. You can click on each one to see its location. If you installed MPLAB IDE into the default directory, the MPASM assembler executable will be:

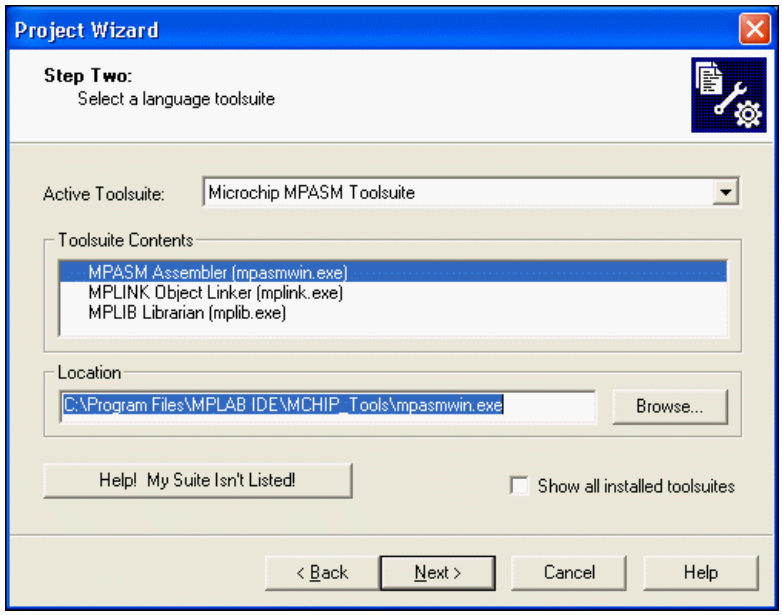
```
C:\Program Files\MPLAB IDE\MCHIP_Tools\mpasmwin.exe
```

and the MPLINK linker executable will be:

```
C:\Program Files\MPLAB IDE\MCHIP_Tools\mplink.exe
```

If these do not show up correctly, use the browse button to set them to the proper files in the MPLAB IDE subfolders.

FIGURE 3-4: SETTING LANGUAGE TOOL LOCATION



When you are finished, click **Next>**. Then, click **OK**.

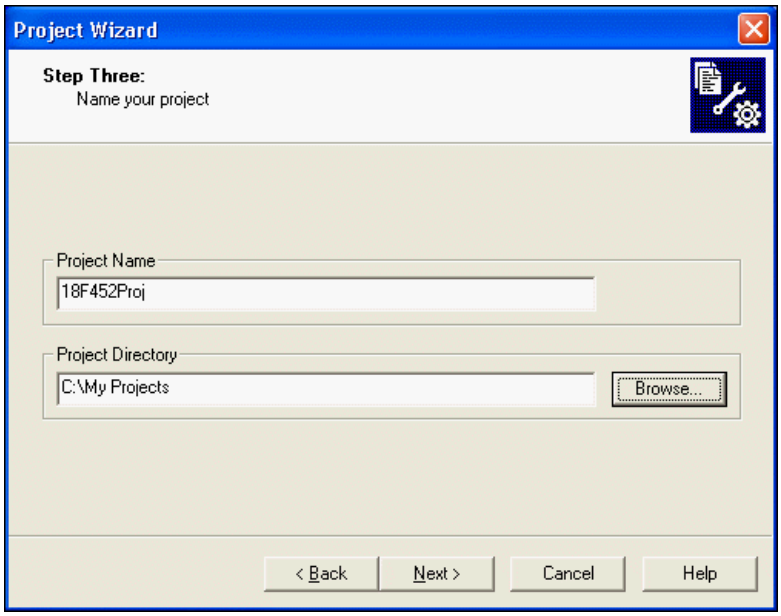
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3.7 NAMING THE PROJECT

Step Three of the wizard allows you to name the project and put it into a folder. This sample project will be called `18F452Proj`, and using the **Browse** button, go to the `C` drive and make a new folder called `My Projects`. Click **Next>**.

FIGURE 3-5: PROJECT WIZARD - NAME PROJECT



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3.8 ADDING FILES TO THE PROJECT

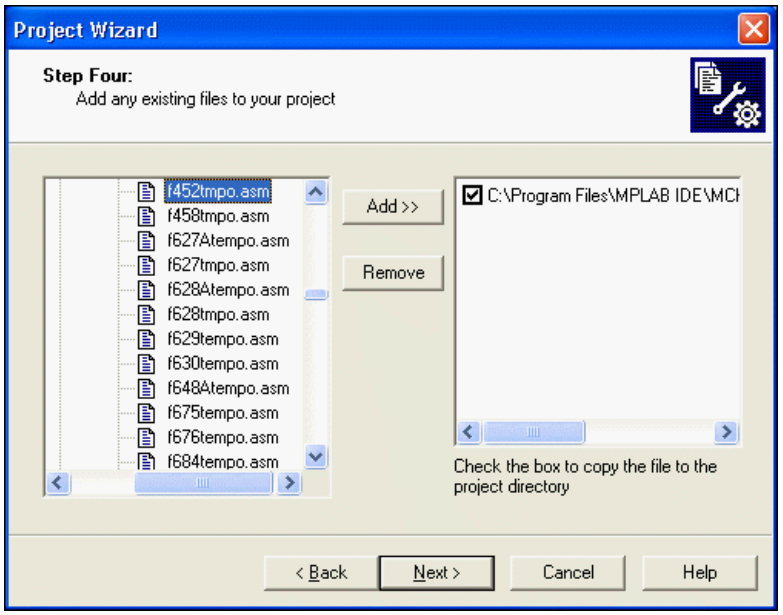
Step Four of the Project Wizard allow us to select files for the project. We do not have a source file yet, so we will use an MPLAB IDE template file. The template files are simple files that can be used to start a project. They have the essential sections for any source file, and have information in them that will help you write and organize your code. These files are the `MPLAB IDE` folder, which by default is in the `Program Files` folder on your PC. There is one template file for each Microchip PICmicro and dsPIC device.

Scroll to the `Program Files` folder on Drive C:, open it, and scroll down to the `MPLAB IDE` folder. Open the `MPLAB IDE` folder and scroll down to the `Mchip_Tools` directory. Open the `Mchip_Tools` directory and get a template from the `Object` folder in the `Template` folder, and choose the file named `f452tmpo.asm`.

If you installed MPLAB IDE in the default location, the full path to the file will be:

```
C:\Program Files\MPLAB IDE\MCHIP_Tools\TEMPLATE\Object\f452tmpo.asm
```

FIGURE 3-6: PROJECT WIZARD - SELECT TEMPLATE FILE



Press **Add>>** to move the file name to the right panel, and click on the check box at the start of the line with the file name to enable this file to be copied to our project directory.

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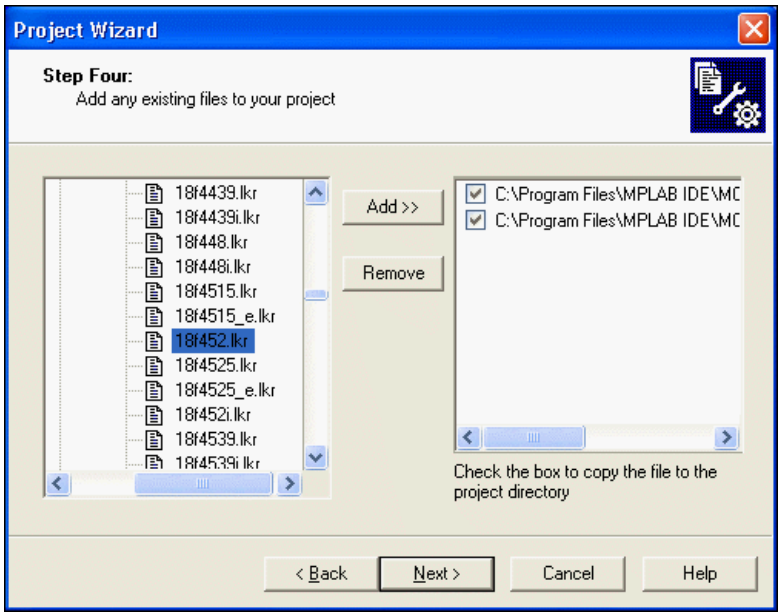
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Now add the second file for our project, the linker script. There is a linker script for each device. These files define the memory configuration and register names for the part. The linker scripts are in the folder named `LKR` under the `MCHIP_Tools` folder. Use the file named `18F452.lkr` The full path is:

```
C:\Program Files\MPLAB IDE\MCHIP_Tools\LKR\18F452.lkr
```

Also click on its check box so we can copy this into our project.

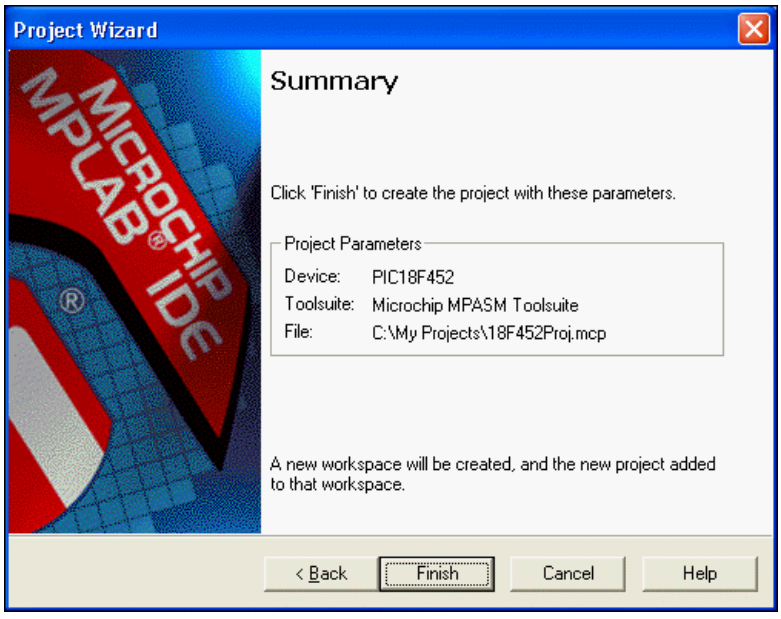
FIGURE 3-7: PROJECT WIZARD - SELECT LINKER SCRIPT



Make sure that your dialog looks like the picture above, with both check boxes checked, then press **Next>** to finish the Project Wizard.

The final screen of the Project Wizard is a summary showing the selected device, the toolsuite and the new project file name.

FIGURE 3-8: PROJECT WIZARD - SUMMARY



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After clicking **Finish**, look at the Project Window on the MPLAB IDE desktop. It should look like Figure 3-9. If the Project Window is not open, select *View>Project*.

FIGURE 3-9: PROJECT WINDOW

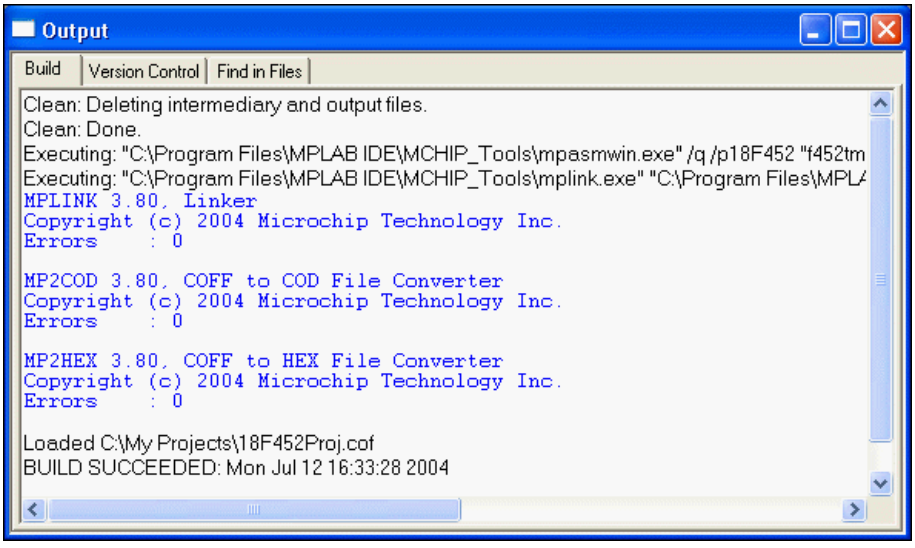


3.9 BUILDING THE INITIAL PROJECT

From the Project menu, we can assemble and link the current files. They don't have any of our code in them yet, but this just assures that the project is set up correctly.

Click back on the 18f452Proj.mcw window to make it the active window. Now, build the project by selecting *Project>Build All*. The Build Results window displays, as shown in Figure 3-10.

FIGURE 3-10: INITIAL BUILD RESULTS WINDOW



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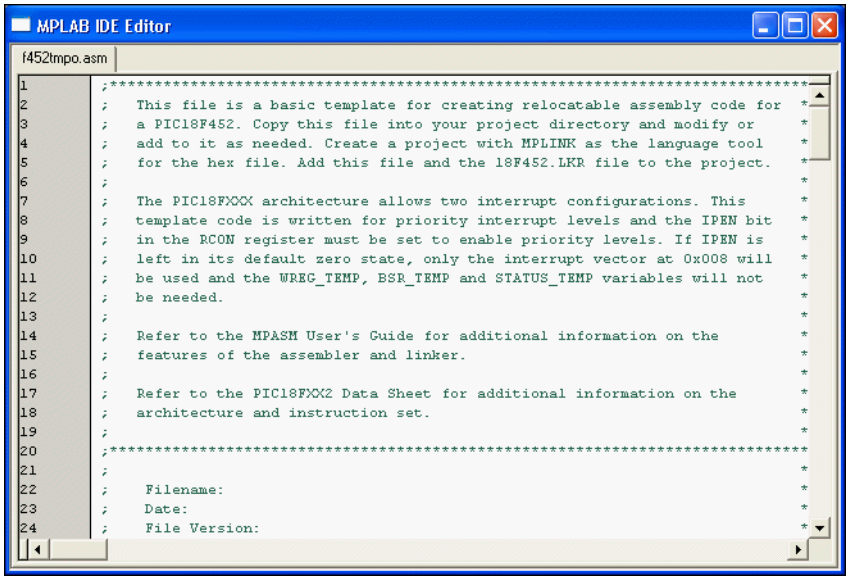
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3.10 CREATING CODE

Open the template file in the project by double clicking on its name in the Project Window (see Figure 3-11).

The file has some comments at the beginning, and this area can be used as a standard comment information header for the file. For now you'll leave this as it is, but if this were a real project, you could put information about your design here.

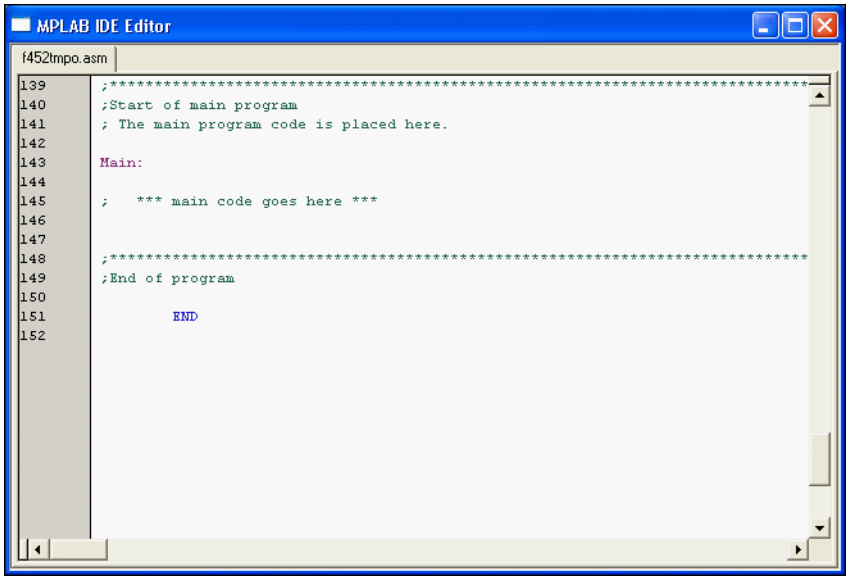
FIGURE 3-11: TEMPLATE FILE



Scroll down to the bottom of the file.

The code in the first part of the file is mainly for more advanced things such as setting up interrupts and configuration bits in a final application. We can ignore those details for now and just write the code. Our code will go into the file at the point after the symbol `Main` is defined.

FIGURE 3-12: TEMPLATE FILE - MAIN



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When any source file is opened, you are automatically in the editor. Type in this code:

```
Main:

    clrf   WREG
    movwf  PORTC; clear PORTC
    movwf  TRISC; configure PORTC as all outputs

Init
    clrf   COUNT
IncCount
    incf   COUNT
    movf   COUNT,W
    movwf  PORTC; display COUNT on PORTC

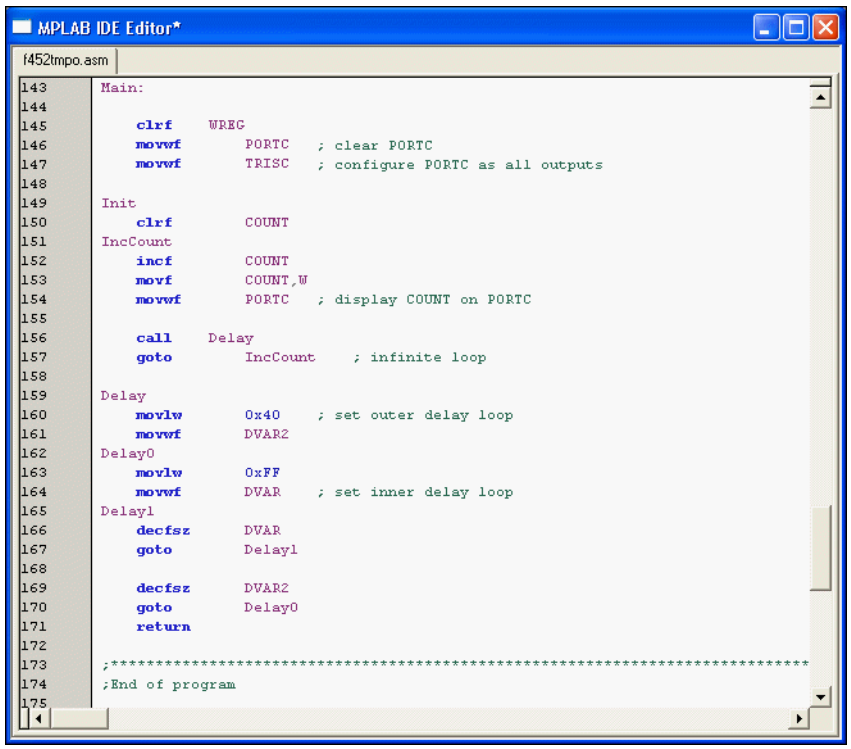
    callDelay
    goto   IncCount; infinite loop

Delay
    movlw  0x40; set outer delay loop
    movwf  DVAR2
Delay0
    movlw  0xFF
    movwf  DVAR; set inner delay loop
Delay1
    decfsz DVAR
    goto   Delay1

    decfsz DVAR2
    goto   Delay0
    return
```

The template file should now look like Figure 3-13.

FIGURE 3-13: TEMPLATE FILE - ADD CODE

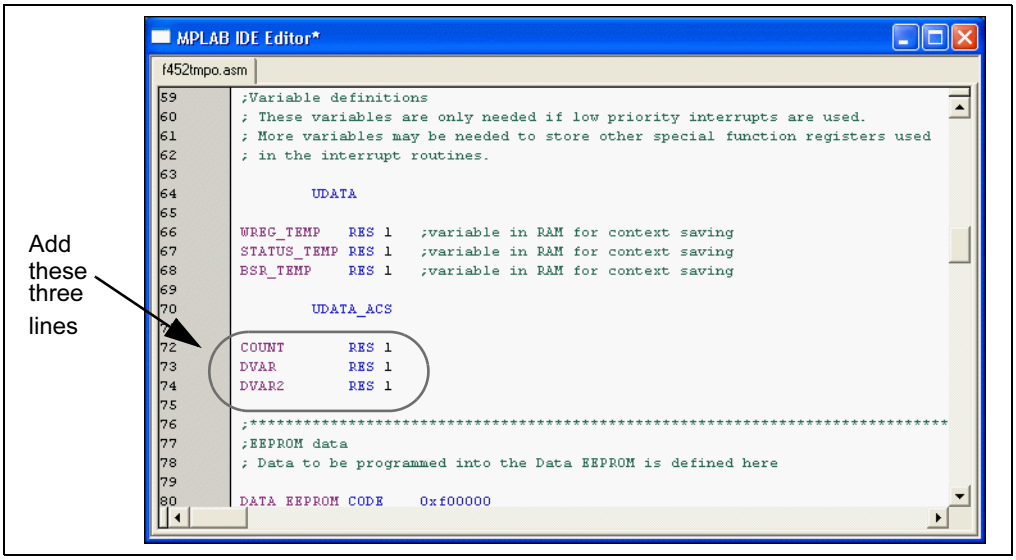


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In this bit of code, we used three variables named COUNT, DVAR and DVAR2. We need to define those in the template file in the section for uninitialized data, a section named UDATA. There are already three variables in this section of the template file, so we can just add ours after them using the same format. Each variable is an 8-bit variable, so they only need to reserve 1 byte each.

FIGURE 3-14: TEMPLATE FILE - ADD VARIABLES

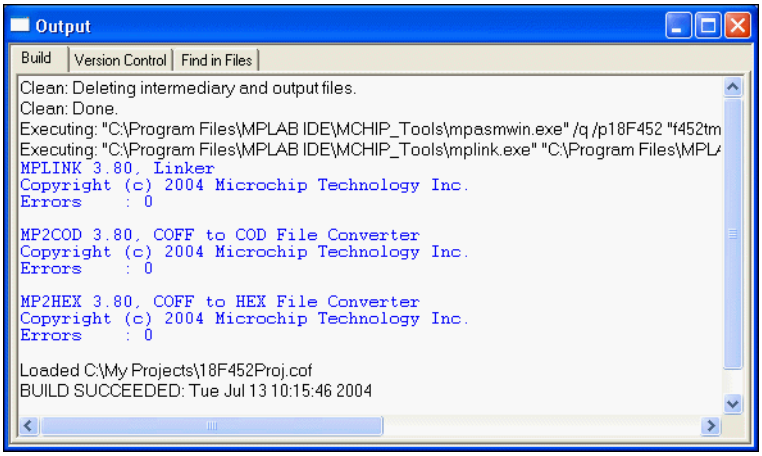


3.11 BUILDING THE PROJECT

Select *Project>Build All* to assemble and link the code.

If the code assembled with no errors, the Output Window will look like Figure 3-15:

FIGURE 3-15: BUILD OUTPUT WINDOW



Save your project by selecting *File>Save Workspace*.

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If these do not assemble and link successfully, check the following items and then build the project again:

- Check the spelling and format of the code entered in the editor window. Make sure the new variables and the special function registers, TRISC and PORTC, are in upper case. If the assembler reported errors in the Output window, double click on the error and MPLAB IDE will open the corresponding line in the source code with a green arrow in the left margin of the source code window.
- Check that the correct assembler (MPASM assembler) and linker for PICmicro devices is being used. Select *Project>Set Language Tool Locations*. Click on the plus boxes to expand the Microchip MPASM toolsuite and its executable files. Click MPASM Assembler (`mpasmwin.exe`) and review their location in the display. If the location is correct, click **Cancel**. If it is not, change it and then click **OK**. The default search paths can be empty.

Upon a successful build, the output file generated by the language tool will be loaded. This file contains the object code that can be programmed into a PICmicro MCU and debugging information so that source code can be debugged and source variables can be viewed symbolically in Watch windows.

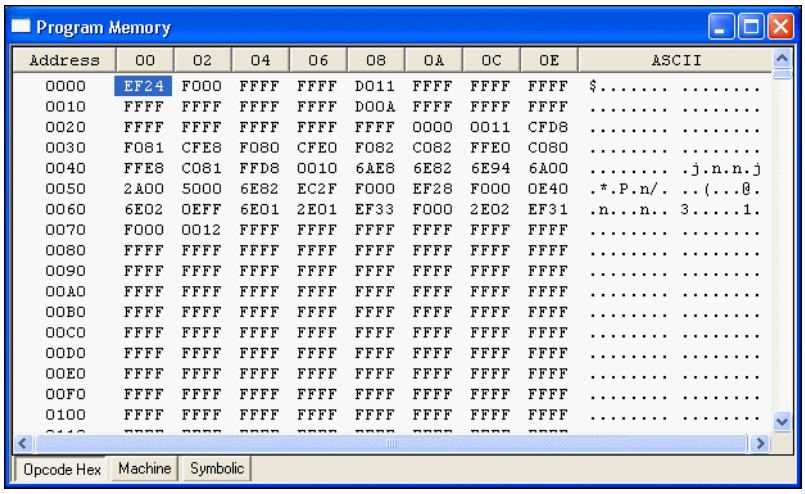
Now that you've built your project successfully, you can prepare for programming your device.

3.12 ENABLING THE PICSTART PLUS

If you haven't already started the PICSTART Plus device programmer, select *Programmer>Enable Programmer*. The PICSTART Plus toolbar will appear when the programmer is enabled.

Select *View>Program Memory* and click on **Opcode Hex** at the bottom of the window (see Figure 3-16) to view the hex code you've just built. You can resize or move the Program Memory window on your display. You may wish to close the Build Results window.

FIGURE 3-16: VIEWING PROGRAM MEMORY



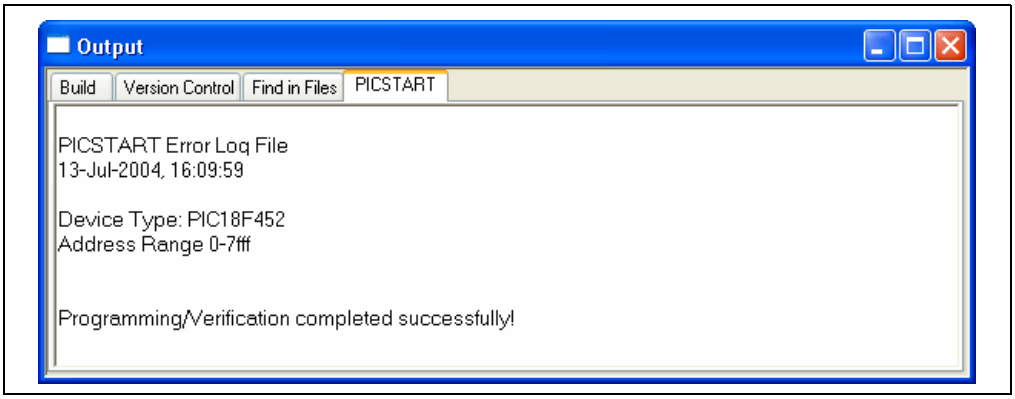
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3.13 PROGRAMMING THE DEVICE

Now that you have your data in program memory, you can program the device. Make sure your PIC18F452 device is properly inserted and latched into the PICSTART Plus socket. Then, select *Programmer>Program*. The MPLAB IDE window will indicate the progress and when finished, the Output window will display the results (see Figure 3-17).

FIGURE 3-17: PROGRAMMING RESULTS



3.14 VERIFYING THE PROGRAMMING

Select *Programmer>Verify* to double check the programming in the device. If any address locations on the device do not match program memory, an error log will display the discrepancies.

3.15 TUTORIAL SUMMARY

We have done the major steps for creating, building and programming our simple project.

We selected the device, the PIC18F452.

We used the Project wizard to create a project, and while using the wizard we:

- selected the MPLAB IDE built in MPASM assembler and MPLINK linker language tools,
- added files for the project: a template file for the device we've selected and a linker script to build it properly.

We wrote some simple code to send a changing value out an I/O port.

Then we built the project.

And finally, we programmed the PIC18F452 device.

These are the essential steps for programming a device with the MPLAB IDE and the PICSTART Plus.

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Chapter 4. Using the PICSTART Plus

4.1 INTRODUCTION

This chapter describes the steps required to program and read a device using the PICSTART Plus development programmer:

- Preparation for Programming a Device
- Procedure for Programming a Device
- Verifying the Programming
- Reading a Device

4.2 PREPARATION FOR PROGRAMMING A DEVICE

Before you begin to program a device, you need to have:

- A hex file to program into the PICmicro MCU device
- A blank PICmicro MCU device to program

You also need to have already:

- Installed the PICSTART Plus hardware and MPLAB IDE software (**Chapter 2. "PICSTART Plus Installation"**)
- Turned on the PICSTART Plus programmer (**Section 2.6 "Turning the PICSTART Plus On/Off"**)
- Established communications between the PC and the PICSTART Plus programmer (**Section 2.9 "Configuring the Serial Port for PICSTART Plus"**)

4.3 PROCEDURE FOR PROGRAMMING A DEVICE

Follow this list of steps to program a device:

Step	Description	See
1	Select the device	**Section 4.3.1 "Selecting the Device"**
2	Select the PICSTART Plus programmer	**Section 4.3.2 "Selecting the Programmer"**
3	Programmer Settings	**Section 4.3.3 "Configuring Programmer Settings"**
4	Enable the PICSTART Plus programmer	**Section 4.3.4 "Enabling the Programmer"**
5	Load a hex file into program memory or assemble/compile one in program memory from your source code	**Section 4.3.5 "Loading a Hex File into Program Memory"**
6	Set up the Configuration Bits dialog	**Section 4.3.6 "Changing the Configuration Bits Settings"**
7	Edit User ID Memory, if needed	**Section 4.3.7 "Using the User ID Memory"**
8	Check that your device is blank	**Section 4.3.8 "Checking For a Blank Device"**
9	Program the device	**Section 4.3.9 "Programming a Device"**

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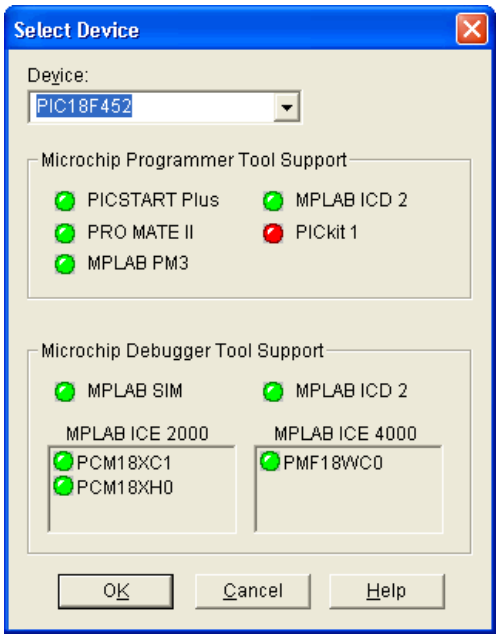
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4.3.1 Selecting the Device

Select *Configure>Select Device* to select the device you wish to program from the list of available devices (see Figure 4-1). When you select a device, indicators next to the Microchip Tools names show the level of support for that device: green - supports the device, yellow - limited support and red - no support. If the selected device is supported by PICSTART Plus, click **OK**.

If a device is selected that is not supported by the PICSTART Plus, the programmer cannot be enabled. An error message will be displayed and the PICSTART Plus will be come unavailable on the Select Programmer list.

FIGURE 4-1: SELECT DEVICE DIALOG



The device list shows the device that is currently selected in MPLAB IDE. Devices that are not listed are not supported by any tool in the version of the MPLAB IDE in use.

4.3.2 Selecting the Programmer

Select *Programmer>Select Programmer>PICSTART Plus* to select PICSTART Plus from the list of available programmers. After PICSTART Plus is selected:

- The Programmer menu changes to include the items applicable to the PICSTART Plus.
- The Programmer Toolbar is displayed.
- The programmer selected. (For more information on menus, toolbars and the status bar, see the MPLAB IDE help as the display of these items is also controlled by the workspace and other configuration settings.)

Ensure that the COM port in use with the PICSTART Plus is the proper one selected in the MPLAB IDE. Select *Programmer>Settings*, then click on the **Communications** tab. Select the port you wish.

Note:	The Debugger selection should be set to "None" while the PICSTART Plus is selected as a Programmer.

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4.3.3 Configuring Programmer Settings

If you need to configure the serial communications port for the PICSTART Plus, select *Programmer> Settings*.(Figure 4-2) and click on the **Communications** tab. A dialog similar to the one shown in Figure 4-3 will appear.

FIGURE 4-2: PROGRAMMER SETTINGS

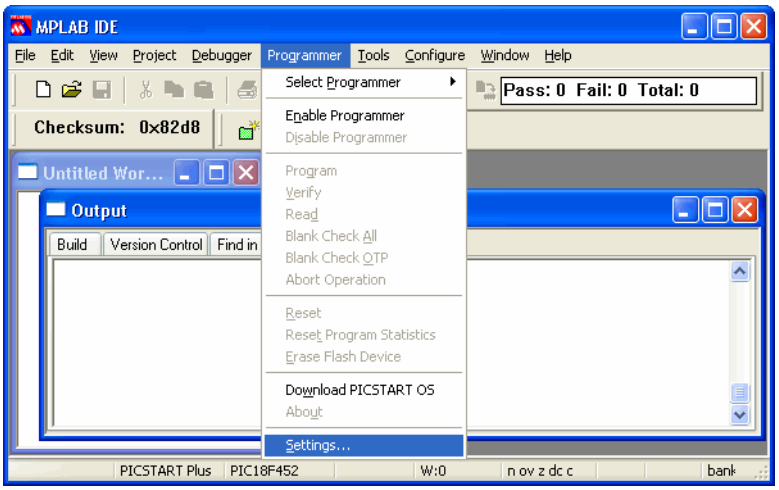
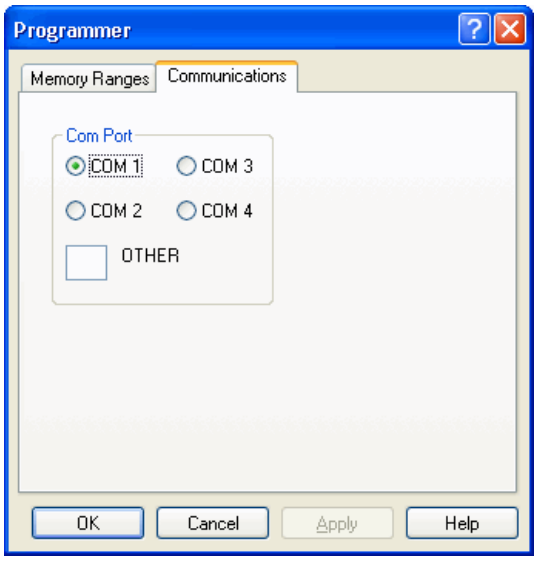


FIGURE 4-3: COMMUNICATIONS PORT SETUP DIALOG



The **Communications** tab shows the possible PC serial communication ports. Select COM port 1-4 or type the port number (5-255) to which you connected the PICSTART Plus, and click **OK**. If a COM port number between 4 and 255 has been configured for use on the workstation, type the number in the “Other” text box. Click **OK** to set the COM port or click **Cancel** if you want to close the dialog without selecting a COM port.

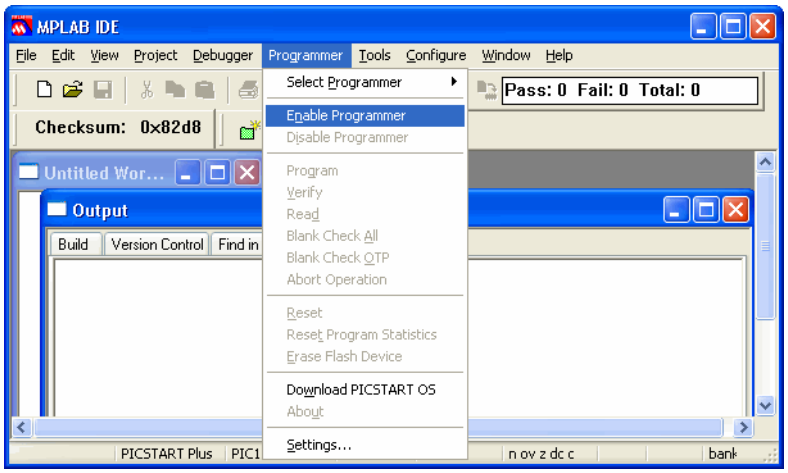
Note: The programmer uses COM 1 as the default serial port. If you change your serial port selection, then the next time you run you programmer, the host software will use the same serial port used in the previous session.

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4.3.4 Enabling the Programmer

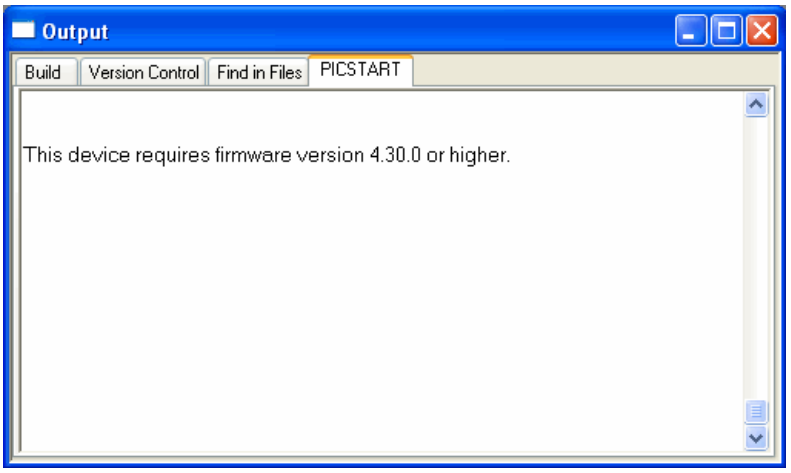
To enable the PICSTART Plus programmer, select *Programmer>Enable Programmer* (see Figure 4-4).

FIGURE 4-4: ENABLING THE PICSTART PLUS



If the device you selected is not supported by the OS firmware version detected on the PICSTART Plus, a message similar to the one in Figure 4-5 will be displayed. This indicates that the device is not supported by the firmware version in use. See **Section 5.8 "Upgrading the PICSTART Plus Firmware OS"**.

FIGURE 4-5: FIRMWARE ERROR MESSAGE

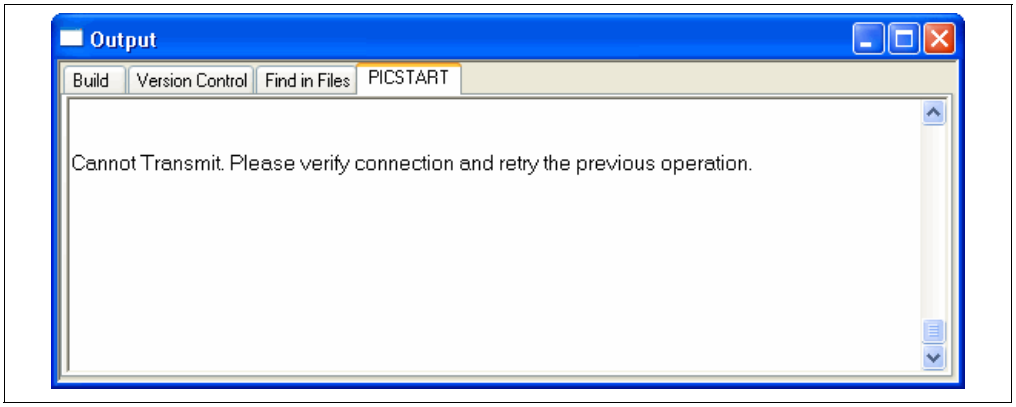


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If communication cannot be established due to problems with the serial connection, a message similar to the one in Figure 4-6 will be displayed. Communications errors can also be caused by the device not being properly aligned in the ZIFF socket.

FIGURE 4-6: COMMUNICATIONS ERROR MESSAGE



If you cannot establish communications between the PC and PICSTART Plus, make sure you have installed the hardware and software correctly (see **Section 2.4 "Installing PICSTART Plus Hardware"** and **Section 2.3 "Installing MPLAB IDE Software"**). If you still cannot establish communications between the PC and PICSTART Plus, please see **Appendix B. "Troubleshooting"**.

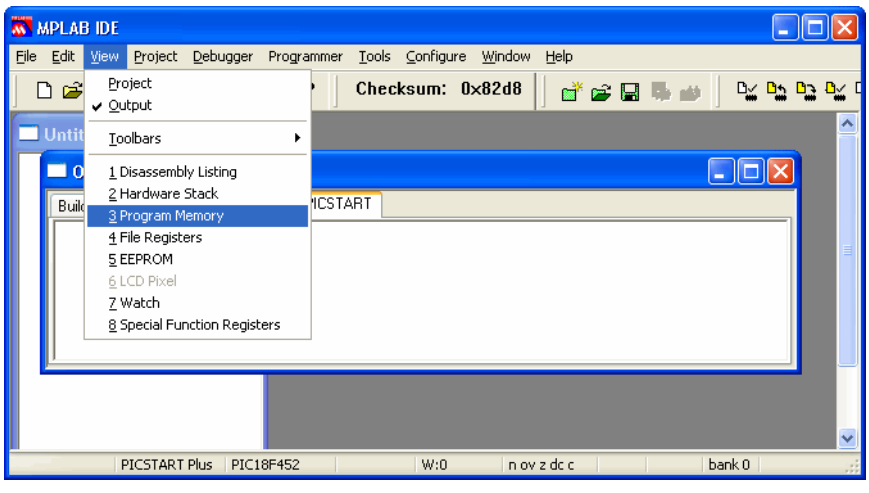
Where possible, new device support on previous versions of the PICSTART Plus firmware OS is allowed. However, some new devices require updates to the PICSTART Plus firmware OS. See **Section 5.8 "Upgrading the PICSTART Plus Firmware OS"** for information on upgrading the PICSTART firmware OS.

4.3.5 Loading a Hex File into Program Memory

4.3.5.1 ABOUT PROGRAM MEMORY

You can view the Program Memory as hex code, machine code, or disassembled with symbols (if available). To view program memory, select *View>Program Memory* (Figure 4-7).

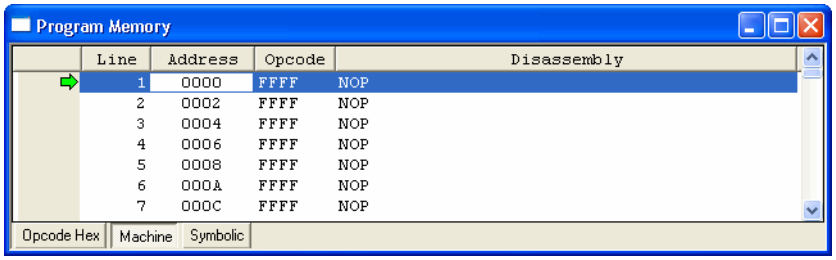
FIGURE 4-7: VIEWING PROGRAM MEMORY



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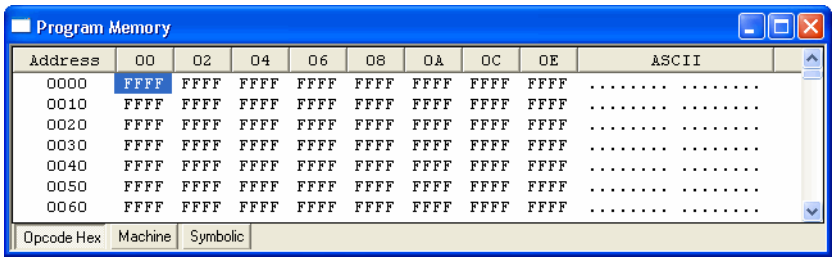
The Program Memory window opens in the Machine mode (Figure 4-8).

FIGURE 4-8: MACHINE MODE



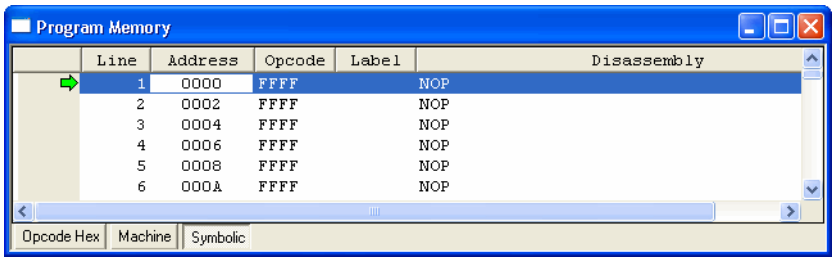
To change display mode, click on a system button in the lower left corner of the window and select the display mode from the system menu. Clicking the **Opcode Hex** button changes the program memory display to be similar to Figure 4-9.

FIGURE 4-9: OPCODE HEX MODE



Clicking the **Symbolic** button changes the program memory to be similar to Figure 4-10.

FIGURE 4-10: SYMBOLIC MODE



Note: After building a project, MPLAB IDE makes a hex file and loads it into program memory. This data can then be programmed into the PICSTART Plus.

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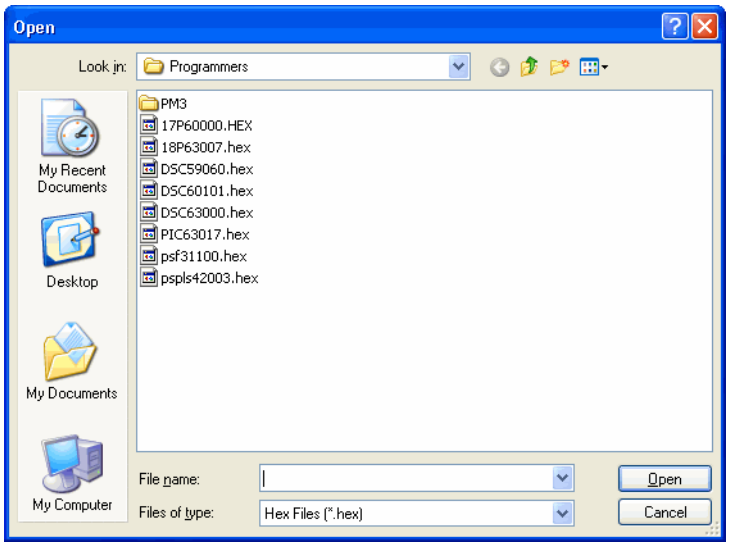
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4.3.5.2 LOADING A HEX FILE INTO PROGRAM MEMORY

If you have a hex file (e.g., `code.hex`) ready for programming into a PICmicro microcontroller, select *File>Import* and navigate to the location of your hex file. Select your hex file and click **Open** (see Figure 4-11) to load your hex code into the MPLAB IDE Program Memory window. If the Program Memory window is not open, select *View>Program Memory* to open it.

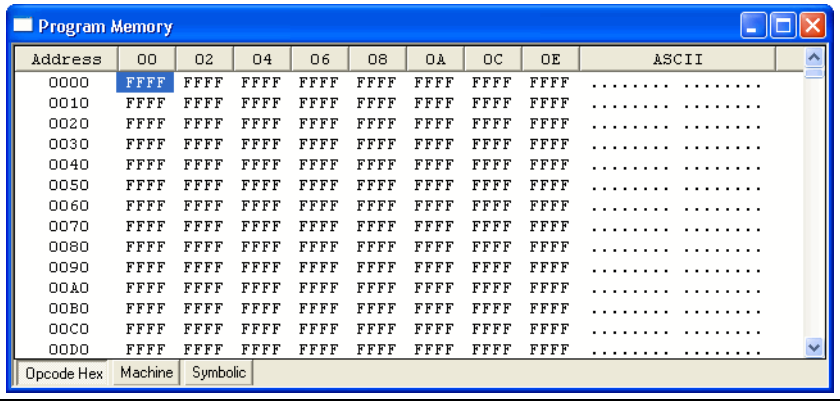
If you do not have a hex file to program your device, you can build one using MPLAB IDE Projects. The MPLAB IDE provides a text editor for generating source code and is compatible with various assemblers/compilers for assembling/compiling your source code into hex code in MPLAB IDE program memory. See the MPLAB IDE Project Tutorial to see how to use MPLAB IDE Projects to develop your own source code. Each time you rebuild your project, the Program Memory window will be updated.

FIGURE 4-11: IMPORT HEX FILE



The Program Memory window should now contain the hex code from the hex file (Figure 4-12). Click on the **Opcode Hex** button to view the hex code.

FIGURE 4-12: PROGRAM MEMORY – HEX CODE DISPLAY



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4.3.5.3 FILE FORMATS USED BY PICSTART PLUS

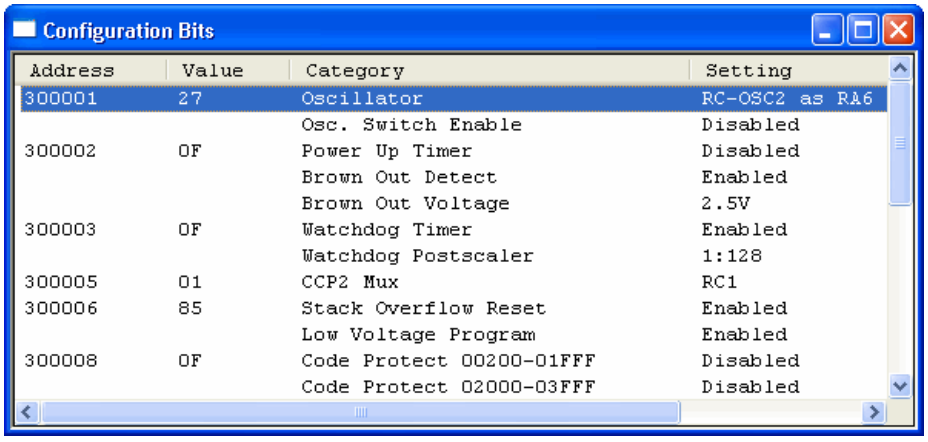
The PICSTART Plus programmer can use information directly from the MPLAB IDE projects without any intermediate steps. The MPASM assembler can be used separately from the MPLAB IDE to produce hex files for the PICSTART Plus programmer. Alternatively, devices can be programmed with hex files from any PICmicro microcontroller-compatible cross-assembler or cross-compiler.

If you are using MPASM assembler separate from the MPLAB IDE, or are generating hex files from within the MPLAB IDE for use later with PICSTART Plus programmer, you should use IINHX32 hex format. MPASM assembler's default output format for hex files is INHX32.

4.3.6 Changing the Configuration Bits Settings

If you need to change the configuration bits for a device from the factory-default settings or if you want to see the configuration bits settings, select *Configure>Configuration Bits* (see Figure 4-13).

FIGURE 4-13: CONFIGURATION BITS WINDOW – PIC18F452



The configuration bits shown in Figure 4-13 are for a PIC18F452 device. The type and number of configuration bits depend on the device selected. For more information on the functions of configuration bits for a particular device, refer to the specific device data sheet.

Note: Changing the configuration bits in the window after building a project or importing a hex file will supersede the values set by these two methods.

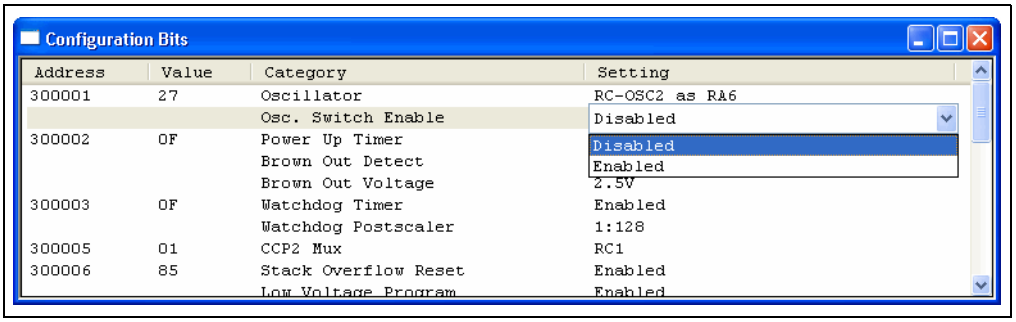
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To change a configuration bits setting:

1. Click on the setting you want to change and a down arrow appears to the right of the setting.
   If you cannot see the down arrow, increase the width of the Configuration Bits window until the down arrow appears.
2. Click the down arrow to view the setting options and select the one you want (see Figure 4-14).

FIGURE 4-14: CHANGING CONFIGURATION BITS SETTINGS



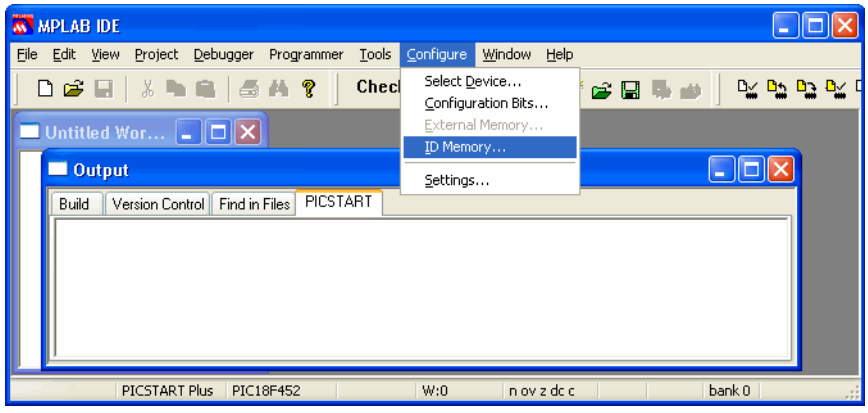
You can also specify the configuration bit values in your source code. Use the MPASM assembler _ _CONFIG directive to set the configuration bits for the device to be programmed. Each time you rebuild your project or reload your hex file, the configuration bits will be set according to the values from this directive. If you do not set configuration bits in your source code, then these bits will not be changed. If you manually change these bits from their default values using this dialog, they will be programmed into the device when you program the microcontroller.

A configuration bit(s) value manually set in the configuration window after a project is built will override the value(s) set by the project.

4.3.7 Using the User ID Memory

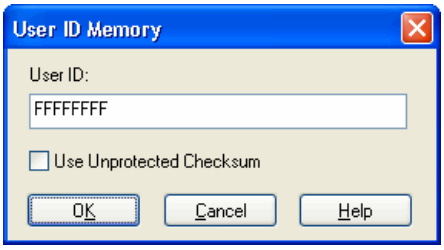
If needed, an ID can be generated for the device by using the ID Option. The ID can be an unprotected checksum derived from the contents programmed into the device or a value designated by the user. The limitations on the value are determined by the device's memory size. Select *Configure>ID Memory* (see Figure 4-15) to open the User ID Memory dialog. Use this dialog to enter a user ID for devices that provide this functionality. Also, select whether or not to "Use Unprotected Checksum" (Figure 4-16).

FIGURE 4-15: CONFIGURING ID MEMORY



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FIGURE 4-16: USER ID MEMORY DIALOG



You can also use the _ _IDLOCS directive to set the ID bytes from the MPASM assembler. Each time you rebuild your project or reload your hex file, the ID locations will be set according to the values from the _ _IDLOCS directive.

Any ID value manually set using the ID memory dialog after a project is built will override the value set by the project.

Click **OK** to set the option or click **Cancel** to cancel the entry.

4.3.8 Checking For a Blank Device

Before performing a Blank Check, ensure that the device is:

- aligned Pin 1 to Pin 1 of the PICSTART Plus ZIFF socket
- the silver lever is pulled down to secure the device in the ZIFF socket.

Select *Programmer>Blank Check All* to verify that the device is completely blank (all bits are set to a '1'). This will also verify that all configuration bits are set to a '1' (unprogrammed state).

If you are using a one-time programmable (OTP) device, some configuration bits might already be programmed from the factory (e.g., oscillator bits). Use the Configuration Bits dialog (*Configure>Configuration Bits*) to set the configuration bits to the factory settings, then select *Programmer>Blank Check OTP*. This will check that all program memory bits are set to '1' and that the configuration bits match the value in the dialog.

Flash devices are automatically erased before programming. OPT devices can be erased, however and EPROM device cannot be erased unless it is in a JW package type (windowed) or a CERQUAD (CL) package type and has not been code-protected. See **Section 4.3.10.3 "Erasing a Windowed Device"**.

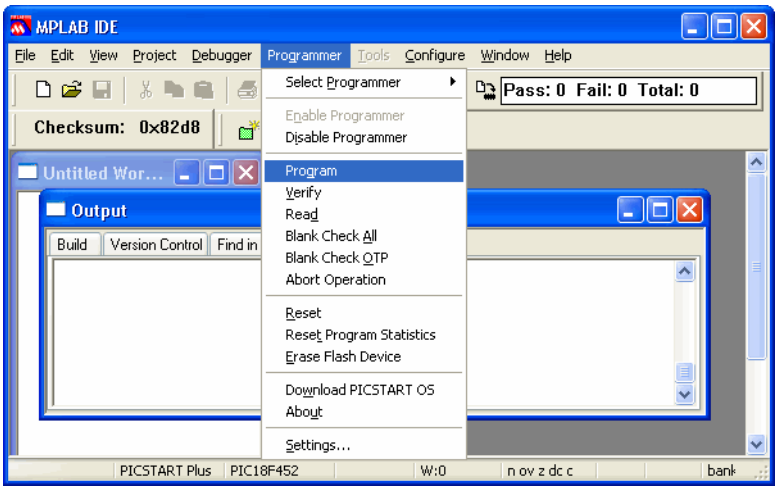
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4.3.9 Programming a Device

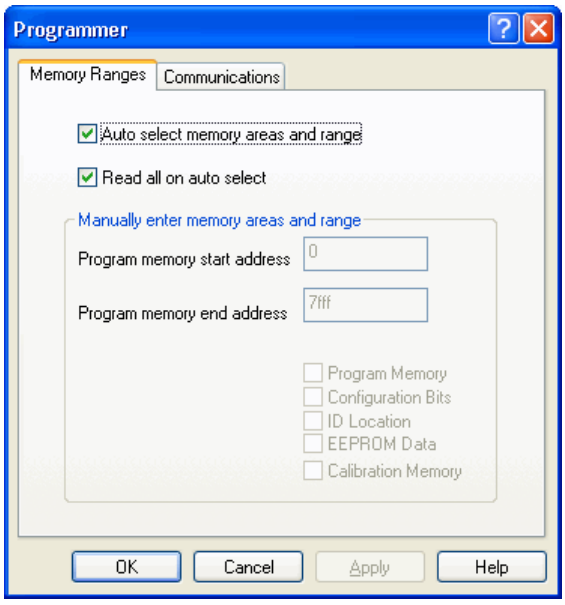
To program the entire device (i.e., all of program memory, configuration bits, etc.), select *Programmer>Program* (Figure 4-17).

FIGURE 4-17: PROGRAMMING A DEVICE



To selectively program part of program memory, first select *Programmer>Settings* and click on the **Memory Ranges** tab to open the Memory Ranges dialog (Figure 4-18).

FIGURE 4-18: SETTING MEMORY RANGES



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The "Auto select memory areas and range" option will be enabled by default when the MPLAB IDE is installed. To selectively program the memory ranges, etc., you must disable this option. Only those memory areas which are applicable to the device will be enabled for selection. To selectively program the memory ranges, configuration bits, etc., adjust the settings in the Memory Ranges dialog (see Table 4-1). The memory area corresponding to the checked boxes will be programmed.

Note: Programming specific memory areas and ranges may not be available if the device has been code-protected. For Flash devices, this action may cause the excluded memory areas and ranges to lose any existing contents.

TABLE 4-1: MEMORY RANGES DIALOG OPTIONS

Auto select memory areas and range	The default is enabled (checked). When enabled, the memory areas and ranges for the selected device are automatically selected by the MPLAB IDE based on the data in its memory. The corresponding memory areas and range information are displayed as checked but unavailable in the manual fields. If the auto select option is disabled (unchecked), you can specify memory areas and ranges.
Read all on auto select	The default is enabled (checked). This option is only available if the "Auto select memory areas and range" option is enabled. When this option is enabled, a Read operation reads the entire device. If disabled, only those areas indicated by the data present in the MPLAB IDE will be read.
Manually enter memory areas and range:	
Program memory start address	The starting address in program memory for programming or verification.
Program memory end address	The ending address in program memory for programming or verification.
Program Memory	Program or verify the program memory for the range specified by Start Address and End Address.
Configuration Bits	Program or verify the configuration bits.
ID Location	Program or verify the User ID. You can set the User ID by selecting *Configure>ID Memory*.
EEPROM Data	For devices with data EEPROM, program or verify the data memory from data in the EEPROM Memory window.
Calibration Memory	For devices with calibration memory, program or verify the calibration memory from data in the Calibration Memory window.

For more information on memory areas, their windows and dialogs in the MPLAB IDE, refer to the MPLAB IDE documentation. Select the options for programming, and click **OK**. Then select *Programmer>Program* to program the device as set in the Memory Ranges dialog.

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4.3.10 Programming Calibration Memory Devices

Special caution should be exercised when working with devices that contain calibration memory. These devices are set at the factory with the calibration parameters stored in a last address of program memory. This value is not the same for all calibration devices.

Calibration memory devices can come in OTP (non-windowed), EEPROM (windowed) and Flash packages.

Non-windowed OTP calibration devices can only be programmed once and cannot be erased. EEPROM calibration devices in a windowed CERDIP (JW) or windowed CERQUAD (CL) package can be erased using an Ultraviolet (UV) EPROM Eraser. If these devices are erased, all memory areas including the calibration data will be erased. Before programming an erased windowed device that contains calibration memory, the correct calibration values must be restored. Flash calibration devices can be erased using the MPLAB IDE software and their calibration data is automatically retained. They do not require any special preparation to reprogram them.

Note:	A windowed device that has been code-protected cannot be properly erased.

Programming or reprogramming a windowed calibration device includes:

- Reading a Calibration Device
- Saving the Calibration Data
- Erasing a Windowed Device
- Restoring Calibration Data

4.3.10.1 READING A CALIBRATION DEVICE

1. Before you begin, uniquely label each device.
2. Use *Configure>Select Device* to choose the needed calibration memory device.
3. Select *Programmer>Select Programmer>PICSTART Plus.*
4. Ensure that the PICSTART Plus hardware has been connected and has the correct socket module for the device. Insert the device into the socket module.
5. Select *Programmer>Enable Programmer* to enable the PICSTART Plus.
6. Open the windows associated with the device memory areas, i.e., the Program Memory and Configuration Bits windows. By default, the memory area windows are cleared by the MPLAB IDE when the device was selected. If not, select *Debugger>Clear Memory>Program Memory* to clear the window.
7. Select *View>Output* to open the Output window.
8. Select *Programmer>Read*. The current values in each of the device areas will be displayed.
9. If you know the device is blank or not code-protected but the Read command displays a message with values that indicate code protection, double check the PICSTART Plus hardware, especially the positioning of the device in the PICSTART Plus ZIFF socket. Additional help information can also be found in the Troubleshooting section under *Help>Topics>PICSTART Plus*.
10. If the Read command was successful, go to the last available address in the Program Memory window to view the calibration value.

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4.3.10.2 SAVING THE CALIBRATION DATA

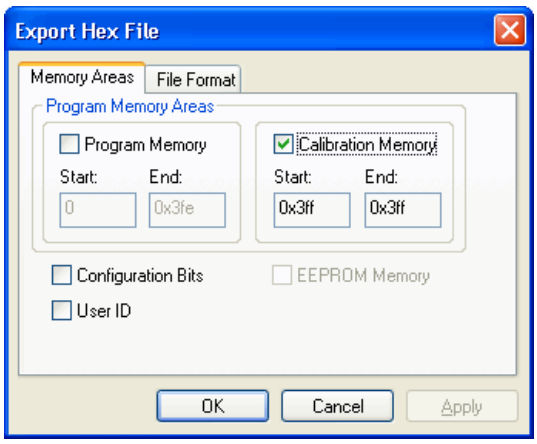
1. If the device is in a windowed package, the calibration data must be saved by doing one of the following:

   a) Write down the calibration value and keep it in a safe place.

   or

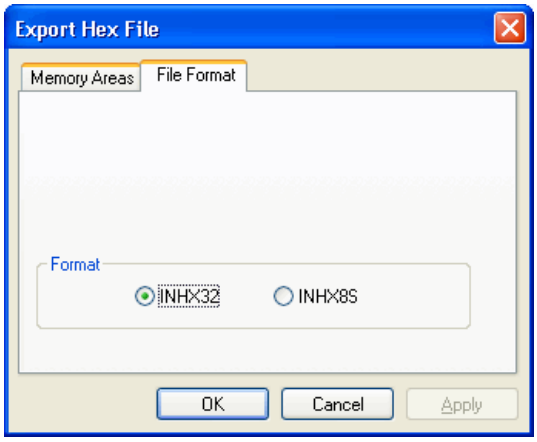
   b) Select *File>Export* to open the Export Hex File dialog. On the **Memory Areas** tab, check only the Calibration checkbox to save the data for this memory area only (see Figure 4-19).

FIGURE 4-19: MEMORY AREAS TAB



On the **File Format** tab, set or allow the default to remain at INHX32 (see Figure 4-20), then click **OK**.

FIGURE 4-20: FILE FORMAT TAB



2. Once the calibration data has been saved, it can be programmed back into the erased device. This should be done before the device is used again to program source code.

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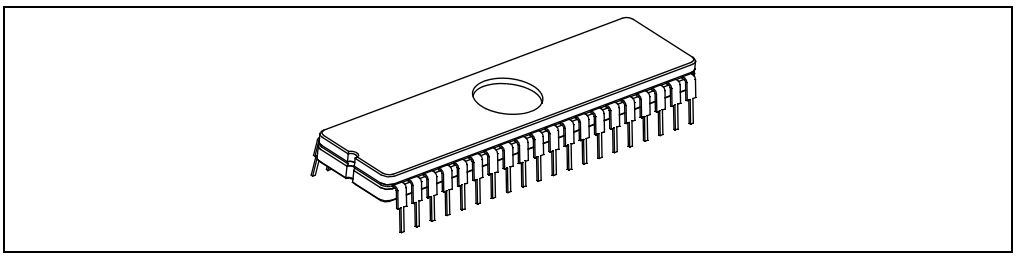
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4.3.10.3 ERASING A WINDOWED DEVICE

To erase a windowed device:

1. Remove any covering that is on top of the device's windows so that the ultraviolet light can flow through to the device. See Figure 4-21.

FIGURE 4-21: WINDOWED DEVICE



2. Place the device in an Ultraviolet (UV) EPROM Eraser. Use the UV eraser as instructed per the equipment manufacturer's instructions. The amount of time required to completely erase the device depends on the wavelength of the light, its intensity, distance from UV source and the process technology of the device (the size of the memory cells).
3. When the UV eraser indicates completion, remove the device.

4.3.10.4 RESTORING CALIBRATION DATA

1. Insert the erased windowed device into the PICSTART Plus programmer socket.
2. Select *Programmer>Blank Check* to ensure that the device is blank. If the device is not blank, it has not been erased.
3. If the device is blank, restore the saved calibration data by either:

   a) Manually entering the saved calibration value into the last address of the program memory window.

   or

   b) Select *File>Import* to import the calibration value from the hex file that contains the information. Browse to the location and select the file. Click **Open**.
4. Once hex that contains the calibration data has been imported, program the device.

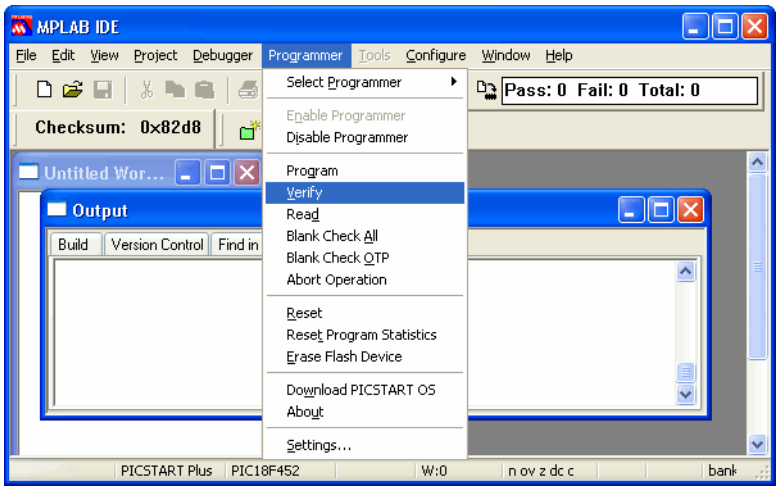
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4.4 VERIFYING THE PROGRAMMING

Select *Programmer>Verify* (see Figure 4-22) to verify that the contents of the device match the program memory, EEPROM data, calibration memory, ID locations and configuration bits in the MPLAB IDE.

If the device's contents do not match what is currently in the MPLAB IDE (displayed in the memory area windows for the device), the Verify will fail.

FIGURE 4-22: VERIFY COMMAND



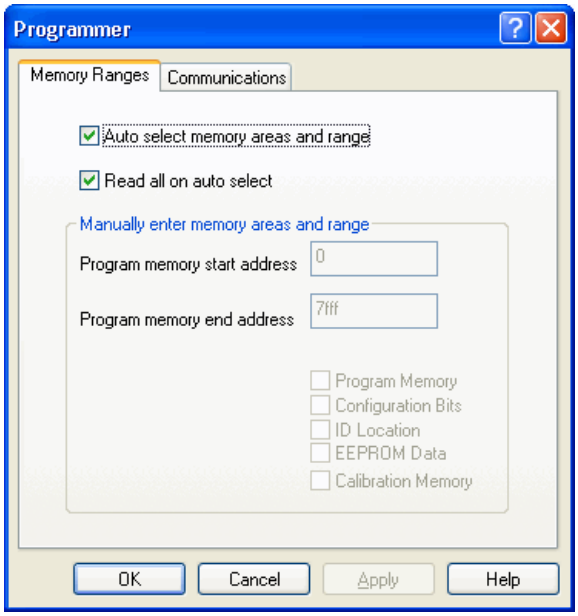
4.5 READING A DEVICE

To read the entire device (e.g., all of program memory, configuration bits, etc.), select *Programmer>Read* in MPLAB IDE.

To selectively read part of program memory, only configuration bits, etc.:

1. Select *Programmer>Settings* and click on the **Memory Ranges** tab (Figure 4-23).

FIGURE 4-23: MEMORY RANGES TAB



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2. If the “Auto select memory areas and range” option is enabled (checked), disable (uncheck) the option. If this option is enabled, you will not be able to manually select the specific memory areas and range.
3. Select the memory areas and ranges to be read. Click **OK**. Refer to Table 4-2 for descriptions of the manual settings.

TABLE 4-2: MEMORY RANGES MANUAL SETTINGS

Program memory start address	The starting address in program memory for programming or verification.
Program memory end address	The ending address in program memory for programming or verification.
Program Memory	Program or verify the program memory for the range specified by Start Address and End Address.
Configuration Bits	Program or verify the configuration bits.
ID Location	Program or verify the User ID. You can set the User ID by selecting *Configure>ID Memory*.
EEPROM Data	For devices with data EEPROM, program or verify the data memory from data in the EEPROM Memory window.
Calibration Memory	For devices with calibration memory, program or verify the calibration memory from data in the Calibration Memory window.

4. Select *Programmer>Read*. The memory area corresponding to the checked boxes will be read.

Once the Read is complete, the memory area windows will display the data read from the device. You can then:

- Modify the data in the Program Memory before you save to a hex file or program another device.
- Save the data as a hex file by selecting *File>Export.*
- Insert a new device into PICSTART Plus to program the data into it.

If you have any problems when attempting to read a device, refer to **Appendix B. “Troubleshooting”**.

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NOTES:

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Chapter 5. PICSTART Plus – MPLAB IDE Reference

5.1 INTRODUCTION

This chapter describes the dialogs, windows and menu items of the PICSTART Plus development programmer system. Refer to the MPLAB IDE documentation or on-line help for additional information.

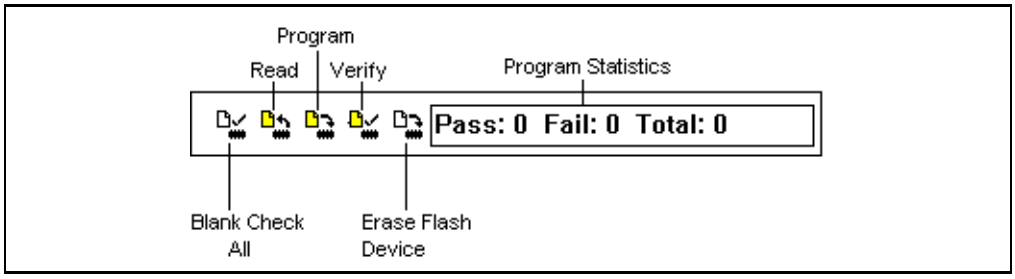
Topics covered in this chapter:

- PICSTART Plus Toolbar
- Configure Menu
- Debugger Menu
- PICSTART Plus Programmer Menu
- Programmer Settings
- Files Used by the PICSTART Plus Programmer
- Upgrading the PICSTART Plus Firmware OS

5.2 PICSTART PLUS TOOLBAR

The PICSTART Plus toolbar (Figure 5-1) consists of icons for some of the programmer functions and a program statistics display.

FIGURE 5-1: PICSTART PLUS TOOLBAR



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Position the mouse pointer over the toolbar item to display the name. The items on the toolbar are shown in Table 5-1.

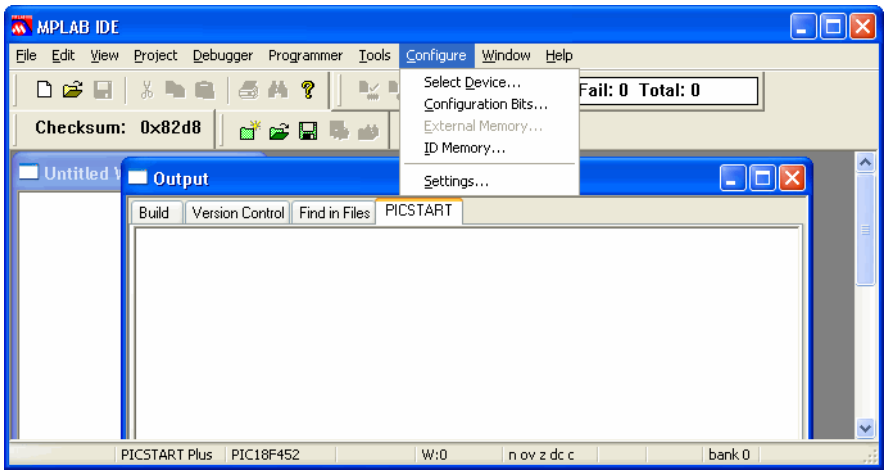
TABLE 5-1: PICSTART PLUS TOOLBAR COMMANDS

Symbol	Command	Description
	Blank Check All	Checks that the device is completely blank (all bits are set to a '1'). This will also check that all configuration bits are set to a '1' (unprogrammed state). (Same as *Programmer>Blank Check All*.)
	Read	Reads the device. (Same as *Programmer>Read*.)
	Program	Programs the device. (Same as *Programmer>Program*.)
	Verify	Verifies that the device was programmed properly. (Same as *Programmer>Verify*.)
	Erase Flash Device	Erase all memory on a Flash Device. (Same as *Programmer>Erase Flash Device*.)
	Program Statistics	Provides the number of programming attempts: passed, failed and total. To clear the values in this display, select *Programmer>Reset Program Statistics*.

5.3 CONFIGURE MENU

The Configure Menu is an MPLAB IDE menu that you use in conjunction with the PICSTART Plus Programmer Menu. Refer to the MPLAB IDE documentation or on-line help for detailed information on the Configure Menu. The Configure Menu (Figure 5-2) consists of five dialog selections listed in Table 5-2.

FIGURE 5-2: CONFIGURE MENU OPTIONS



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TABLE 5-2: CONFIGURE MENU

Selection	Description
Select Device	Select the supported device you wish to program. (Support for devices is indicated by green for supported, yellow for limited support and red for no support.)
Configuration Bits	Select values for the device configuration bits. Setting these values will affect both debugger and programmer operation.
External Memory	Select whether to use external memory or not. Also specify external memory range.
ID Memory	Enter value into ID memory.
Settings	Enter default setting for the workspace, debugger, program loading, hot keys and project.

5.4 DEBUGGER MENU

The Debugger Menu is an MPLAB IDE menu that contains options to selected the MPLAB Simulator, Emulator and Debugging tools; however, it also has options under *Debugger>Clear Memory* (see Figure 5-3) that can be used with the PICSTART Plus to clear the MPLAB IDE memory areas and their associated windows (see Table 5-3). It sets the particular memory area to the values seen when the device is blank.

FIGURE 5-3: DEBUGGER CLEAR MEMORY MENU OPTIONS

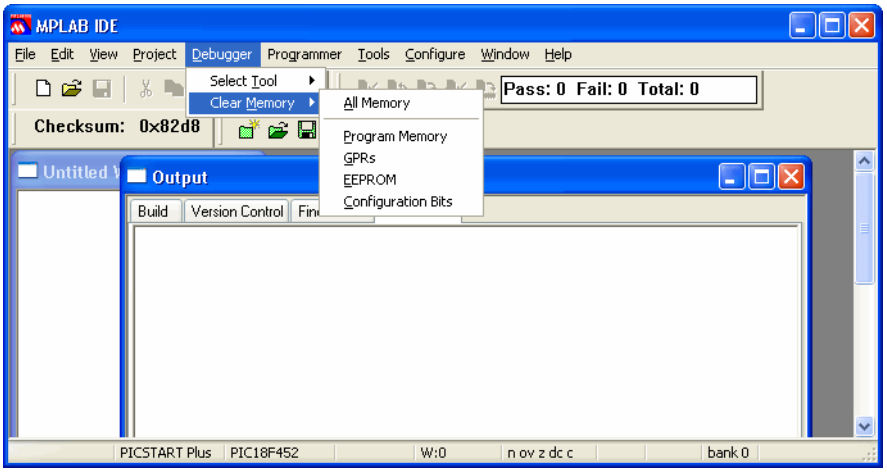


TABLE 5-3: DEBUGGER MENU

Selection	Description
All Memory	Clears the MPLAB IDE memory areas of all data and associated windows
Program Memory	Clears the MPLAB IDE program memory data and its window
GPR	Clears the MPLAB IDE general purpose register data and its window
EEPROM	Clears the MPLAB IDE EEPROM data and its window
Configuration Bits	Clears the MPLAB IDE configuration bit data and its window

Note: Using the Clear Memory options does not erase the contents of the device.

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5.5 PICSTART PLUS PROGRAMMER MENU

Once you select the PICSTART Plus programmer, the full programmer menu displays (see Figure 5-4 and Table 5-4). You must enable the programmer to make additional menu items available. Some of the PICSTART Plus menu items are accessible through the PICSTART Plus toolbar.

FIGURE 5-4: PICSTART PLUS PROGRAMMER MENU

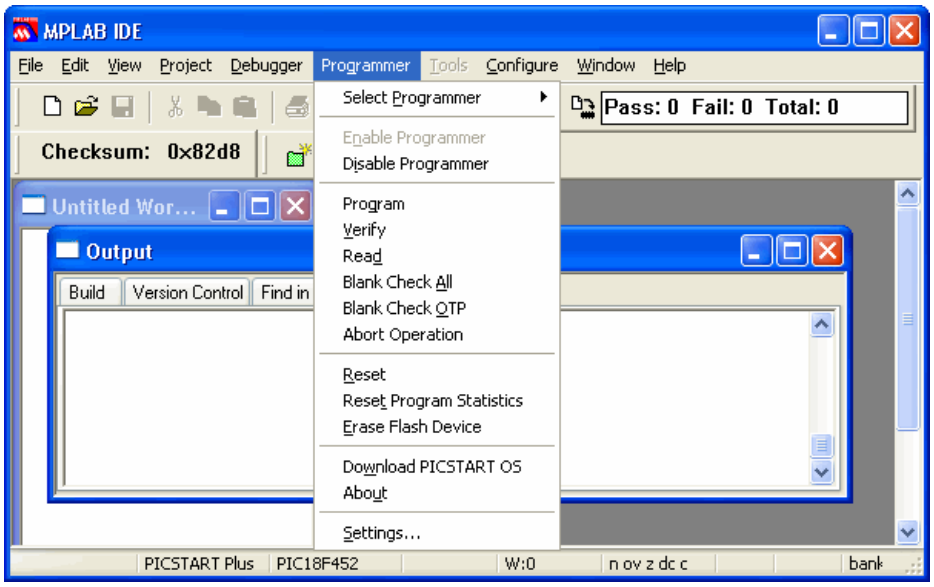


TABLE 5-4: PICSTART PLUS MENU

Programmer Menu Option	Toolbar Icon	Function
Select Programmer		Lists the available programmers.
Enable Programmer		Enables the programmer.
Disable Programmerr		Disables the programmer.
Program		Programs the device.
Verify		Verifies that the device was programmed properly.
Read		Reads the device content. Selective read (e.g., part of program memory, only configuration bits of the device) can be done by setting up "Settings" below.
Blank Check All		Checks that the device is completely blank (all bits are set to a "1"). This will also check that all configuration bits are set to a "1" (unprogrammed state).

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TABLE 5-4: PICSTART PLUS MENU (CONTINUED)

Programmer Menu Option	Toolbar Icon	Function
Blank Check OTP		This function is intended for use with OTP devices that come with factory programmed configuration bits. Before using this function, set the displayed configuration bits to match the factory programmed settings. The function verifies that all program memory bits are set to “1” and that the configuration bits match the settings displayed in the Configuration Bits dialog.
Abort Operation		Cancels a Program, Verify or Read operation in progress.
Reset		Resets the programmer hardware and reestablishes RS-232 communications. Use this option if power has been disconnected from the programmer. This option does not reset programming information in the Program Memory window, configuration bits, or IDs.
Reset program statistics		Resets the counters in the Program Statistics area.
Erase Flash Device		Available for flash devices only. Erases the flash memory in the device.
Download PICSTART OS		Opens the Download PICSTART Plus Operating System dialog displaying a listing of the available firmware versions. Download should only be performed if a different version of the firmware is needed to support a device or it contains a fix to a problem.
About		Displays the programmer's firmware OS version information.
Settings		Opens the Programmer dialog, which allows you to set the memory ranges and the communications port. Programmer options Program, Read and Verify are controlled by these settings.

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5.5.1 Select Programmer

To select the PICSTART Plus programmer, choose *Select Programmer>PICSTART Plus*. Once the programmer is selected, the Output window opens.

5.5.2 Enable Programmer

To enable the PICSTART Plus programmer, select *Programmer>Enable Programmer*. When attempting to enable the PICSTART Plus, the following can occur:

- Communication is successful, the device is supported by the firmware version in use and, the firmware version in use is the latest available as detected by the MPLAB IDE. No messages will be displayed. The PICSTART Plus toolbar will be made available and the Programmer menu will be updated to the items associated with the use of the PICSTART Plus.
- The version of the firmware detected by the MPLAB IDE is older than that known to be the latest version. The PICSTART Plus will be made ready for use, but a "newer firmware" message will be displayed. It is not necessary to download this newer firmware version to make the PICSTART Plus work.
- The version of the firmware in use does not support the selected device. A "firmware required" message will be displayed. The PICSTART Plus cannot be used until the version of the firmware that supports the selected device is downloaded. See **Section 5.8 "Upgrading the PICSTART Plus Firmware OS"**.
- Communication errors are received. See **Appendix B. "Troubleshooting"**, **Section B.2 "Common Problems"**.

5.5.2.1 OUTPUT WINDOW

When you select *Programmer>Select Programmer>PICSTART Plus* from the PICSTART Plus menu or select *View>Output* from the MPLAB IDE menu, the Output window opens. This window contains tabbed information about program output. Refer to the MPLAB IDE documentation for more information.

The menu items in the Output window available from the right mouse button menu are:

- Select All – Selects all text and graphics in the Edit window.
- Copy – Copies the selected text in the current window onto the clipboard. After this operation, you can paste the copied text into another MPLAB Editor window, into another location in the same MPLAB Editor window, or into another Windows application.
- Clear Page – Clears the contents of the Output window.

Note:	It is best to keep the Output window open as all message are posted here.

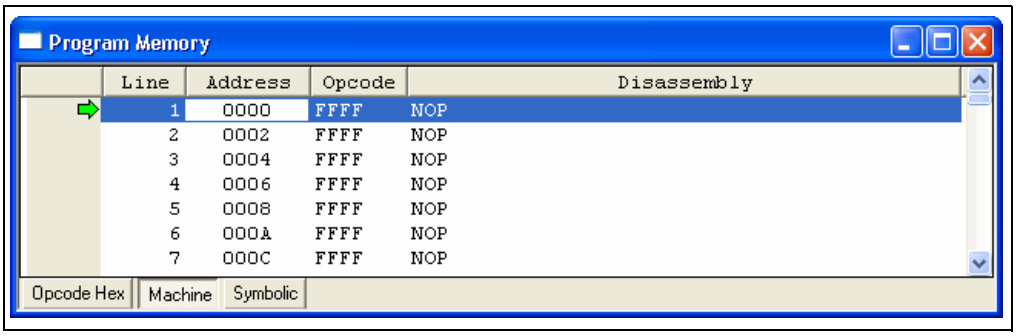
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5.5.2.2 PROGRAM MEMORY WINDOW

When you select *View>Program Memory* from the MPLAB IDE menu, the Program Memory window (Figure 5-5) opens in machine code view.

FIGURE 5-5: PROGRAM MEMORY WINDOW



You can view the Program Memory as hex code, machine code or disassembled with symbols (if available). Change display mode by clicking on the display option button in the lower left corner of the window.

When a Read is performed, a project built or an Import performed that is using this memory area, the program memory window will be overwritten. If the MPLAB Simulator is in use along with the PICSTART Plus, be sure that the contents of the MPLAB IDE are those you wish to have programmed into the device before using the Program option.

5.5.3 Disable Programmer

To disable the PICSTART Plus programmer, select *Programmer>Disable Programmer*.

5.5.4 Program

Select *Programmer>Program* to program the entire device (i.e., all of the program memory, configuration bits, etc.).

If you want to program selectively (e.g., part of program memory, only configuration bits), select *Programmer>Settings* to open the Programmer Settings dialog. Click the **Memory Ranges** tab and select the options for programming. Areas that are grayed out are not available on the device. Click **OK**. Then select *Programmer>Program* to program the device. The memory area corresponding to the checked boxes will be programmed.

After PICSTART Plus programs a device, it automatically performs a verify operation and displays any errors found. An additional verify operation may be done via selecting *Programmer>Verify*.

5.5.5 Verify

To verify the programming on the device, select *Programmer>Verify*. This verifies that the programming on the device matches the program memory, configuration bits, ID locations, EEPROM and calibration memory values in MPLAB IDE (those currently displayed in the memory area windows) and in the Settings dialog.

If there are more errors than expected and those errors claim that the bad data is all zeros (0000), the device may not be seated properly in the PICSTART Plus or aligned Pin 1 to Pin 1 in the ZIFF socket. It is always a good practice to insert a known blank device and do a blank check whenever the socket module is changed.

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When the programming is finished, "`Programming/Verification completed successfully!`" will be displayed in the Output window. If the programming failed, an error message will appear showing the good (expected) data and the bad (actual) data for the memory areas it attempted to program.

5.5.6 Read

To read the entire device (i.e., all of program memory, configuration bits, etc.), select *Programmer>Read*.

To read selectively (e.g., part of program memory, only configuration bits), select *Programmer>Settings>Memory Ranges* to display the Memory Ranges dialog (see **Section 5.6.1 "Memory Ranges Tab"**). Select the memory areas to be read, then click **OK** in this dialog. Areas that are grayed out are not available on the device. Then, select *Programmer>Read*. The memory area corresponding to the checked boxes will be read.

Once the Read is complete, the Program Memory window will display the data read. You can save that data as a hex file, insert a new device into PICSTART Plus to copy that same data into a new device (this is known as programming from a Master Device), or modify the data in MPLAB IDE before you save to a hex file or program another device.

If you attempt to read a code-protected device, you will get a warning indicating that the device is code-protected and that the program memory may be invalid.

5.5.7 Blank Check All

After inserting the device in the socket, select *Programmer>Blank Check All* from the PICSTART Plus menu. This check will verify that the device is completely blank (all bits are set to a '1') and all configuration bits are set to a '1' (unprogrammed state).

When complete, the results will be displayed in the Output window, for example:

```
Configuration memory is blank.
EEData memory is blank.
ID memory is blank.
Program memory is blank.
```

If you are using a one-time programmable (OTP) device, some configuration bits (e.g., oscillator bits) might have already been programmed at the factory and report that the device is not blank. Make sure the configuration bits are set to the factory settings and select *Programmer>Blank Check OTP*. This will check that all program memory bits are set to '1', and that the configuration bits match the value in the dialog. If an EPROM device that has not been code-protected is found not to be blank, it can be erased. See **Section 4.3.10.3 "Erasing a Windowed Device"**.

5.5.8 Abort Operation

When selected, it will abort a Program, Verify or Read operation that is in progress. For example, if you selected *Programmer>Program*, then decided to cancel that operation, by selecting *Programmer>Abort Operation* you can cancel the Program command.

CAUTION
Aborting a program operation can leave a device in an unknown state as some programming will probably have already taken place.

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5.5.9 Reset

If you experience a loss of power to the programmer during operation, you may need to reset the PICSTART Plus programmer. Select *Programmer>Reset* to reset the programmer hardware and reestablish RS-232 communications. Reset does not clear the data in the MPLAB IDE or the contents of the device.

5.5.10 Reset Program Statistics

To reset all the program statistics, select *Programmer>Reset Program Statistics*. This command will reset the display that keeps track of "passes" and "fails" when the device is programmed.

5.5.11 Erase Flash Device

With the device inserted the socket, select *Programmer>Erase Flash Memory* from the PICSTART Plus menu. Then, select *Programmer>Blank Check All* from the PICSTART Plus menu. This check will verify that the device is completely blank (all bits are set to a '1') and all configuration bits are set to a '1' (unprogrammed state).

Note: OTP devices cannot be erased. EPROM devices cannot be erased using the Erase Flash Memory option. See **Section 4.3.10.3 "Erasing a Windowed Device"**.

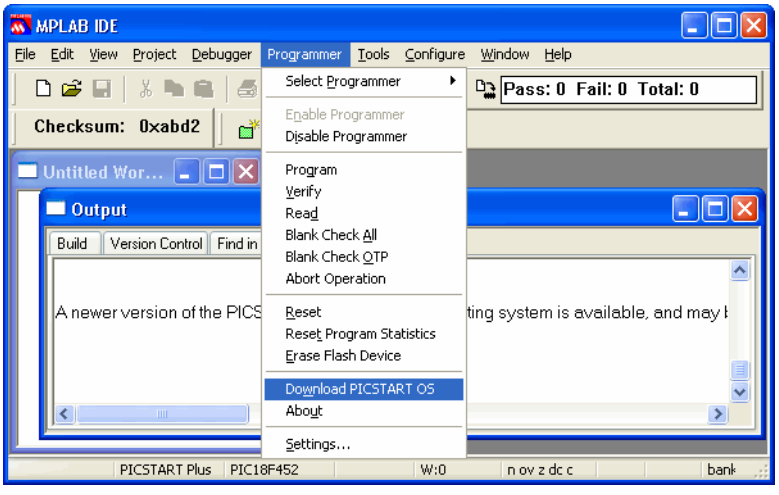
5.5.12 Download PICSTART OS

To download firmware you must have:

- PICSTART Plus that has been upgraded to use the PUM, PICSTART Plus of Revision 20 or higher
- MPLAB IDE 6.40 or higher. MPLAB IDE 6.61 or higher is preferable.

When you select the Download PICSTART OS option, a dialog similar to Figure 5-6 displays.

FIGURE 5-6: DOWNLOAD PICSTART PLUS OS



Select the `PSPLS*.HEX` file you wish to download and click **Open**. When finished, the system displays a "`Download Complete`" message.

5.5.13 About

Select *Programmer>About* to display version of the PICSTART Plus OS firmware version in the programmer.

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5.6 PROGRAMMER SETTINGS

Select *Programmer>Settings* to display the Programmer Settings dialog.The dialog has tabs for setting memory ranges and communications.

5.6.1 Memory Ranges Tab

Select *Programmer>Settings* and click on the **Memory Ranges** tab to select device memory areas for programming (see Table 5-5).

TABLE 5-5: MEMORY RANGES OPTIONS

Selection	Description
Auto select memory areas and range	The default is enabled (checked) (see **Section 5.6.1.1 "Auto Option Enabled"**). When enabled, the memory areas and ranges for the selected device are automatically selected by the MPLAB IDE. The corresponding memory areas and range information are displayed as checked but unavailable in the manual fields. If the auto select option is disabled (unchecked) (see **Section 5.6.1.2 "Auto Option Disabled"**), you can specify memory areas and ranges.
Read all on auto select	The default is enabled (checked). This option is only available if the "Auto select memory areas and range" option is enabled. When this option is enabled, a Read operation reads the entire device. If disabled, only the memory areas and ranges indicated by the data in the MPLAB IDE will be read. (See **Section 5.6.1.1 "Auto Option Enabled"** and **Section 5.6.1.2 "Auto Option Disabled"** for further explanation.)
Manually enter memory areas and range:	
Program memory start address	Type the start address for the range of program memory (in hex).
Program memory end address	Type the end address for the range of program memory (in hex).
Program Memory	Select this check box if you want to program Program Memory. The program memory range is determined by the Program memory start and end address fields.
Configuration Bits	Select this check box if configuration memory is to be programmed.
ID Location	Select this check box if the ID location is to be programmed.
EEPROM Data	Select this check box if the EEPROM data memory is to be programmed.
Calibration Memory	Select this check box if calibration memory to be programmed.

Note: Only those memory areas which are applicable to the device will be available for selecting.

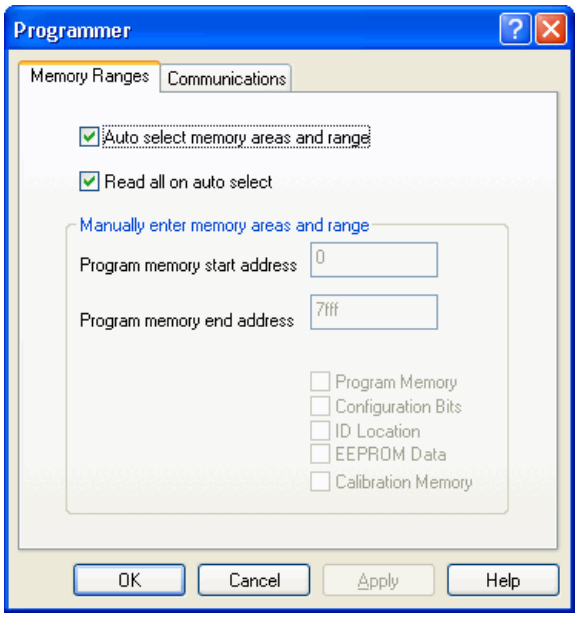
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5.6.1.1 AUTO OPTION ENABLED

The “Auto select memory areas and range” and the “Read all on auto select” options will be enabled by default when the MPLAB IDE is installed (Figure 5-7). Changes are saved when the workspace is saved. If no data is present in the MPLAB IDE, only the Blank Check and Erase options will be available on the Programmer menu and the PICSTART Plus toolbar. However, if one area of memory in the MPLAB IDE contains data, either because a hex file was imported or a project was built, the Program and Verify options will also be available on the Programmer menu and the PICSTART Plus toolbar. The corresponding memory area and range information will display as checked and disabled on the **Memory Ranges** tab.

FIGURE 5-7: MEMORY RANGES TAB - AUTO SELECT ENABLED

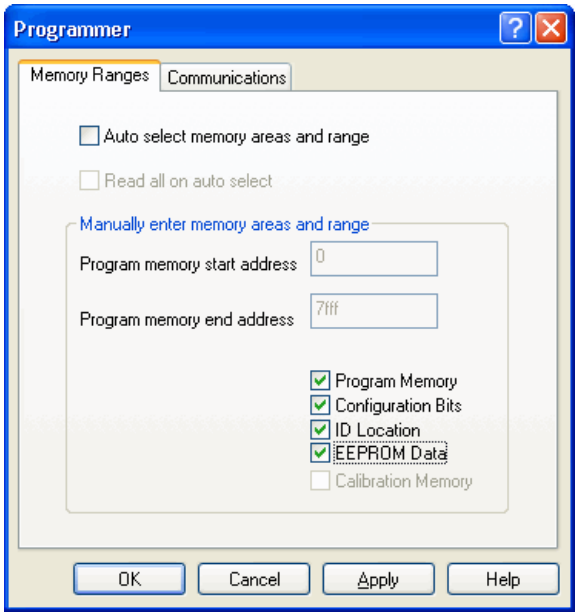


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5.6.1.2 AUTO OPTION DISABLED

If the "Auto select memory areas and range" is disabled, it automatically disables the "Read all on auto select" option. Memory areas and ranges can then be manually specified (see Figure 5-8). The selection of the memory areas and ranges, not the presence of data in the MPLAB IDE memory, controls the availability of the Program and Verify options on the Programmer menu and the PICSTART Plus toolbar. The memory area check boxes and range selection will still control what will be Read, Programmed and Verified. No message will be posted to the Output window stating which memory areas will be included in the Read operation.

FIGURE 5-8: MEMORY RANGES TAB - AUTO SELECT DISABLED



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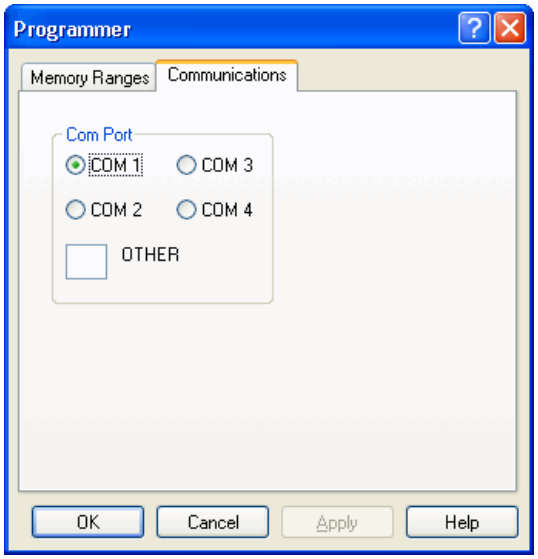
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5.6.2 Communications Tab

To set the port for communications between the programmer and the PC, select *Programmer>Settings* and click on the **Communications** tab. Communications between the programmer and the PC is via an RS-232 (serial) connection. Select the PC COM port you want to use: COM1, COM2, COM3, COM4 or type in a port number (up to 255) in the "OTHER" field (Figure 5-9). COM1 is the default. Click **OK**.

Note: Any port designated for use must have the properties set for proper communication with the PICSTART Plus. See **Section B.2.1.2 "COM Port Setup"**.

FIGURE 5-9: COMMUNICATIONS TAB



To make sure the port is set up properly, follow the instructions in **Section 2.4.1 "Installing the Communications Cable"**.

5.7 FILES USED BY THE PICSTART PLUS PROGRAMMER

The PICSTART Plus programmer can use information directly from the MPLAB IDE projects without any intermediate steps. The MPASM assembler can be used separately from the MPLAB IDE to produce hex files for the PICSTART Plus programmer. Alternatively, devices can be programmed with hex files from any PICmicro microcontroller-compatible cross-assembler or cross-compiler.

If you are using MPASM assembler separate from the MPLAB IDE, or are generating hex files from within the MPLAB IDE for use later with PICSTART Plus programmer, you should use either INHX8M or INHX32 hex formats. MPASM assembler's default output format for hex files is INHX32. If you are programming PIC17CXXX or PIC18XXX devices, you should use INHX32 format.

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5.8 UPGRADING THE PICSTART PLUS FIRMWARE OS

To support new devices, you may need to upgrade the PICSTART Plus firmware OS. How you upgrade the firmware OS will depend on whether or not you have the PICSTART Plus Flash Upgrade Module (PUM) installed in your programmer.

The PUM is a printed circuit board (PCB) that contains a PIC18F6720 device programmed with the firmware OS needed to provide support to a specific set of devices in the MPLAB IDE. The PUM is used to replace the PIC17C44 device inside the PICSTART Plus. The PIC17C44 device can only support up to firmware OS V3.11. The PUM uses Flash technology to upgrade the PICSTART Plus firmware OS when new device support is available through the MPLAB IDE.

This section provides information on:

- Checking if the PICSTART Plus Has a PUM
- Determining the Need for a PUM
- Installing the PUM
- Verifying the PUM is Working Correctly
- Downloading New Firmware
- Verifying the PICSTART Plus Firmware Update

5.8.1 Checking if the PICSTART Plus Has a PUM

PICSTART Plus units that have a revision letter of R20 or higher already come equipped with the PUM or have a PIC18F6720 already built into its PCB. The revision letter of a PICSTART Plus unit is the letter 'R' followed by a number, which can be found on back on the bottom of the plastic enclosure next to the serial number. Another way to determine the firmware OS in use is to select *Help>About* after enabling the PICSTART Plus in the MPLAB IDE. If the firmware OS version is not 4.0.5 or higher, the PICSTART Plus does not contain a PUM.

5.8.2 Determining the Need for a PUM

Device support is the key item to consider when determining whether or not a PUM is needed. The need for newer firmware OS can by indicated by the following:

- Consult the Readme for PICSTART Plus file, which is found in the `\MPLAB IDE\Readme` directory where the MPLAB IDE application is installed on the workstation. This file details the minimum firmware OS version needed to support a device. If the firmware OS version in the PICSTART Plus does not support the desired device, it will need to be upgraded.
- Enable the PICSTART Plus in the MPLAB IDE. If you receive a message stating the device requires a particular version of the firmware, it indicates that the firmware OS version detected by the MPLAB IDE is less than what is needed to support the selected device. The PICSTART Plus will need to be upgraded to the firmware OS version that supports the desired device. If the PICSTART Plus uses a PUM or has a PIC18F6720 already built into its PCB, the newer firmware OS can be downloaded using a Programmer menu option in the MPLAB IDE. If not, the PIC17C44 inside of the PICSTART Plus will need to be replaced.

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It is highly advisable to purchase a PUM to use with an older PICSTART Plus for the following reasons:

- The PICSTART Plus firmware OS version is earlier than 2.01 and the MPLAB IDE needs to be used.
- There will be no more firmware OS releases based on the PIC17C44. These releases ended with firmware OS version 3.11 found in file `psf31100.hex`.
- As newer devices become available for use and are added to the MPLAB IDE selection list, their support will be added to the PICSTART Plus firmware OS. Thus the PUM will provide ongoing use of the PICSTART Plus. Firmware files applicable to the PUM are named `psplsxxxxx.hex`, where *xxxxx* is the version.

5.8.3 Installing the PUM

The PICSTART Plus Flash Upgrade Module (PUM) PCB replaces the existing PIC17C44 microcontroller in the U21 socket inside your PICSTART Plus enclosure. Once this processor upgrade is installed you will no longer need to open the PICSTART Plus, burn a new device and replace the microcontroller in the socket to upgrade the firmware OS. Future firmware OS upgrades can be accomplished by MPLAB IDE reprogramming the FLASH memory of the microcontroller on this upgrade PC board via the existing serial port.

An upgraded PICSTART Plus unit will function with:

- MPLAB version 5.62 or higher
- All MPLAB IDE versions

To install the upgrade PCB if the PICSTART Plus contains a PIC17C44, follow the directions below:

5.8.3.1 REQUIRED EQUIPMENT

To install the processor upgrade, you will need:

- PICSTART Plus Processor Upgrade Module, supplied with kit
- Phillips head screwdriver

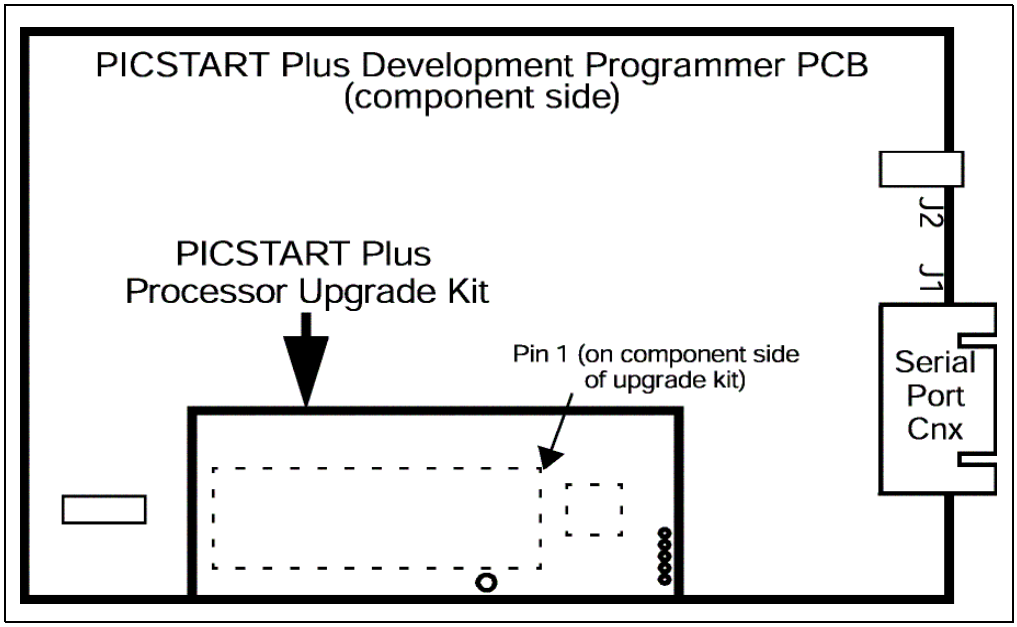
5.8.3.2 INSTALLATION

1. Disconnect the PICSTART Plus from the computer serial port and power supply.
2. Carefully remove the four Phillips head screws from the back of the PICSTART Plus. Remove the back cover.
3. Carefully remove the PIC17C44 microcontroller from the U21 socket.
4. Carefully insert the PICSTART Plus Processor Upgrade Kit into the U21 socket, making sure that Pin 1 is properly oriented (Pin 1 should be close to the serial port connector).

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FIGURE 5-10: PROCESSOR UPGRADE MODULE



5. Put on the back cover making sure to align the hole in the Processor Upgrade Kit with the plastic support in the back cover.
6. Insert the Phillips head screws into the holes in the back cover. Carefully tighten each screw slowly as the plastic housing can be damaged if too much torque is applied to the screws.
7. Reconnect the PICSTART Plus programmer to the computer serial port and power supply.

5.8.4 Verifying the PUM is Working Correctly

When the PUM is used to replace a PIC17C44, or the very first time a PICSTART Plus is used, proper functioning of the hardware should be ensured:

- Check the physical connection of the serial cable to the workstation and hardware.
- Make sure the communication port selected in the MPLAB IDE matches the one in use.
- Select a device (*Configure>Select Device*) that is supported by the earliest version of firmware OS (2.01) that can be used with the MPLAB IDE, such as the PIC16F84A.
- Select *Programmer>Select Programmer>PICSTART Plus* as the programmer.
- Select *Programmer>Enable Programmer*. If you can successfully enable the programmer without receiving communication error messages, the hardware is working properly.

Note: An announcement that newer firmware is available is not a communication error message. No action is required.

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5.8.5 Downloading New Firmware

New firmware OS should only be downloaded if it is needed for device support or if the newer firmware OS contains a fix to a known problem. Firmware releases in the MPLAB IDE have backward compatibility – it supports the devices that were included in the previous release of the firmware OS. There are however some devices that are not supported by the MPLAB IDE.

To download firmware you must have:

- PICSTART Plus that has been upgraded to use the PUM, PICSTART Plus of Revision 20 or higher
- MPLAB IDE 6.40 or higher. MPLAB IDE 6.61 or higher is preferable.

If you receive a message stating the device requires a particular version of the firmware OS, it indicates that the firmware OS version detected by the MPLAB IDE is less than what is needed to support the selected device. The PICSTART Plus will need to be upgraded to the firmware OS version that supports the desired device. For information on the first supported release of a device in firmware OS, refer to the *Readme for PICSTART Plus.txt*.

Perform the following steps to ensure a successful download:

1. In MPLAB IDE, select *Configure>Select Device* and choose a device that is supported by the earliest version of firmware OS (2.01) that can be used with the MPLAB IDE, such as the PIC16F84A.
2. Select *Programmer>Select Programmer>PICSTART Plus*.
3. Select *Programmer>Enable Programmer*.
4. Select *Programmer>Download PICSTART OS*. When the dialog is displayed, select the needed version from the list of firmware OS files. OS files are of the form `psplsversion.hex`, where `version` is the OS version number. Full release versions end in '00'.

Note:	If MPLAB IDE detects an OS that is less than v4.00, it will not download an upgraded OS.

5. Click **Open** to start the download process.

Note:	While the download is taking place, do not attempt to perform other tasks in the MPLAB IDE.

   When the download completes, a message regarding its status will be displayed in the Output window.

6. Select *Programmer>Disable Programmer* to disable the PICSTART Plus.
7. Then, select *Programmer>Enable Programmer* so the change in the firmware OS version will be recognized by the MPLAB IDE.

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5.8.6 Verifying the PICSTART Plus Firmware Update

1. Start the MPLAB IDE v6.xx software.
2. Select *Programmer>Select Programmer>PICSTART Plus* to select the PICSTART Plus programmer.
3. Select *View>Output* to open the Output window.
4. Select *Programmer>Enable Programmer* to begin using the PICSTART Plus programmer.
5. Select *Programmer>About* to display the PICSTART Plus firmware OS version.

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Appendix A. Hardware Specifications

A.1 INTRODUCTION

This appendix covers:

- Connecting to a PC via the Serial Port
- Physical Dimensions and Layout

A.2 CONNECTING TO A PC VIA THE SERIAL PORT

The PICSTART Plus programmer interfaces to the PC via a standard RS-232 port with a DB9 connector. The unit defaults to a 19.2K baud rate.

Serial port communications is as follows:

- 8 data bits, 1 stop bit, no parity
- Hardware flow control
- FIFO Buffers should be disabled

Table A-1 provides the data for connecting the PICSTART Plus programmer (9-pin straight-through) to a 25-pin serial port. Connect the corresponding terminals indicated on each line of the table.

TABLE A-1: PC HOST TO PICSTART PLUS SIGNALS

25-pin (PC-Host)			9-pin (PICSTART Plus)	
2	TX	⟷	2	RX
3	RX	⟷	3	TX
20	DTR	⟷	4	DTR
7	Common	⟷	5	Common
6	DSR	⟷	6	+5 volts (pulled up)
4	RTS	⟷	7	CTS
5	CTS	⟷	8	RTS

A.3 PHYSICAL DIMENSIONS AND LAYOUT

The PICSTART Plus programmer has the physical dimensions of 6 inches x 4 inches x 14/16 inch. Top and back views of the programmer are shown in Figure A-1 and Figure A-2, respectively.

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FIGURE A-1: PICSTART PLUS TOP VIEW

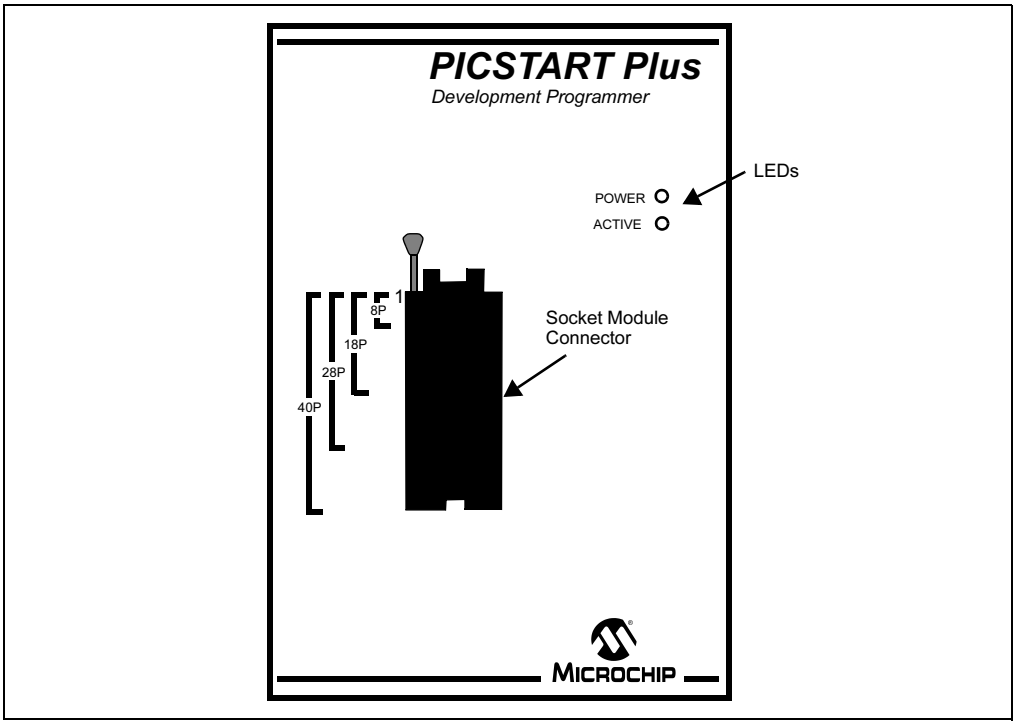
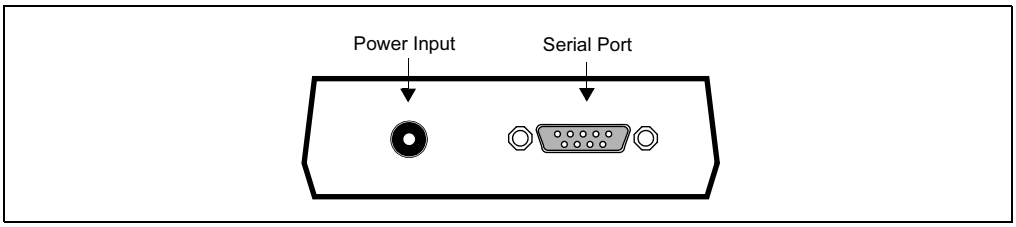


FIGURE A-2: PICSTART PLUS BACK VIEW



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Appendix B. Troubleshooting

B.1 INTRODUCTION

This appendix provides information for troubleshooting the PICSTART Plus programmer including:

- Common Problems
- Error Messages, Warnings and Announcements
- Limitations

B.2 COMMON PROBLEMS

- Failure to Establish Communication with PICSTART Plus
- Advanced Serial Communications Help
- No Programmer Options Visible
- Incompatible Software and Operating System Versions
- Blank Check Problems
- LED Indicators Flicker or Do Not Light
- Device Pin Damage
- Download Not Successful

B.2.1 Failure to Establish Communication with PICSTART Plus

MPLAB IDE attempts to establish communication with the PICSTART Plus device programmer when you enable the programmer. If communication cannot be established, no programming can occur. A message appears in the Output window if the attempt to establish communication fails.

- General Communications Troubleshooting
- COM Port Setup

B.2.1.1 GENERAL COMMUNICATIONS TROUBLESHOOTING

1. Make sure that the RS-232 cable is connected, the power supply is connected and the power LED on the programmer is on.
2. Try connecting the programmer to a different serial port. If your PC has a 25-pin serial port, you will need a 25-to-9 serial port adapter.
3. Make sure that a COM port is properly set up exclusively for use by the programmer. Check the resources to ensure they are operating properly and that there are no conflicts with other devices. If other hardware is detected on the designated COM port or the COM port is being used by software at the time communication is attempted, it will fail. Consult your Windows manual or other reference literature. You can try removing, reconfiguring, or disabling the conflicting device or software, but do so only if you are familiar with those procedures. See **Section B.2.1.2 "COM Port Setup"**.
4. Some system errors are caused by driver and hardware incompatibility. See **Section B.2.1.2 "COM Port Setup"**.

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5. Make sure you are not using a third party communications driver. See **Section B.2.2.4 "Third Party Communications Drivers"** for more information.
6. If a virtual serial port is in use (such as that generated by a USB-to-Serial Adapter), ensure that the properties for the assigned COM port have been properly set. See **Section B.2.1.2 "COM Port Setup"**.
7. Firmware version is less than 2.01. MPLAB IDE versions require that firmware 2.01 or higher be used.
8. MPLAB 5.61 or lower is in use with firmware version 3.11 or higher. Use of firmware version 3.11 or higher with the 16-bit version of MPLAB requires version 5.62 or higher.

For more information, see **Section B.2.2 "Advanced Serial Communications Help"**.

B.2.1.2 COM PORT SETUP

Windows COM port setup requires special attention. If you suspect a driver-hardware incompatibility, go through the Control Panel and try changing Flow Control to Hardware and/or turning off the FIFO for the serial port. Follow the instructions for your PC's operating system:

Windows 98/ME

1. Click the **System** icon.
2. Click the **Device Manager** tab.
3. Click on **Ports**. If necessary, expand the Ports selection by clicking the '+' sign next to it.
4. Double click the COM port to which the programmer is connected.
5. Set the "Flow control:" to "Hardware."
6. Click on **Advanced**, uncheck the "Use FIFO buffers" checkbox and click **OK**.
7. Reboot the PC to implement the change.

Windows NT

1. Click the **Ports** Icon.
2. Select the COM port, click **Settings**. Set the "Flow Control" to Hardware.
3. Click on **Advanced**, uncheck the "FIFO Enabled" checkbox and click **OK**.
4. Reboot the PC to implement the change.

Windows 2000/XP

1. Click the **System** Icon.
2. Click the **Hardware** tab.
3. Click on **Device Manger**.
4. If necessary, expand the Ports selection by clicking the '+' sign next to it.
5. Double click the COM port to which the programmer is connected.
6. Set "Flow control:" to "Hardware."
7. Click the **Port Settings** tab and click on **Advanced**.
8. Uncheck the "Use FIFO buffers" checkbox and click **OK**.
9. Reboot the PC to implement the change.

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B.2.2 Advanced Serial Communications Help

Here are some areas that can cause serial communications problems.

- Modem Interaction
- Problems With A Serial Mouse
- Interrupt Conflicts
- Third Party Communications Drivers

B.2.2.1 MODEM INTERACTION

The programmer cannot be on the same communications port or the same interrupt as a modem or any other hardware. To rectify the problem, either disable the other hardware, move one or the other to a different communications port, or remove the hardware.

B.2.2.2 PROBLEMS WITH A SERIAL MOUSE

If you have a serial mouse, make sure you are not accidentally specifying that communications port as your programmer port.

B.2.2.3 INTERRUPT CONFLICTS

Check that your system has no interrupt conflicts. Make sure that only one device is using each interrupt.

Windows 98/ME

1. Select *Settings>Control Panel* from the Start menu.
2. Select **System** and click on the **Device Manager** tab.
3. Expand the Ports selection and make sure there are no conflict indicators.

Windows NT/2000/XP

1. Select *Settings>Control Panel* from the Start menu.
2. Select **System** and expand the **Ports** list.
3. Click on a COM port from the list, then click the **Port Settings** tab.
4. In the Port Settings dialog, click **Advanced**.
5. Make sure there are no IRQ conflicts.

B.2.2.4 THIRD PARTY COMMUNICATIONS DRIVERS

The programmers are designed to run with the drivers shipped with the Windows operating system. Third party drivers may or may not work. Check the driver designated for the COM port in use. If it is not the driver provided by Microchip, it will need to be changed.

B.2.3 No Programmer Options Visible

You must select a device supported by the firmware in use, then select the programmer before the programmer options are available. Select *Programmer>Select Programmer* and choose PICSTART Plus from the list.

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B.2.4 Incompatible Software and Operating System Versions

The versions of software and operating system are mixed. The PICSTART Plus programmer and the MPLAB IDE software include compatibility checks to ensure that version requirements are met. The latest PICSTART Plus software and OS firmware are included in the installation of the MPLAB IDE. Be sure to use the latest version of the MPLAB IDE.

B.2.5 Blank Check Problems

Some blank check problems you may experience include:

- PIC16C73, PIC16C74: Known Blank Part Shows To Be Non-blank
- When Reading A Blank PIC16C55A, PIC16C57C or PIC16C57, Program Memory Values Of 0xBFF Are Reported

B.2.5.1 PIC16C73, PIC16C74: KNOWN BLANK PART SHOWS TO BE NON-BLANK

When programming some PIC16C7X (PIC16C73, PIC16C74) devices, a known blank part will show to be not blank and will not program properly. The problem occurs because the rise time of VPP is too fast to properly set the part into programming mode. This occurs only on certain date codes of parts and only on non PIC16C7XA parts.

Insert a 0.01 mF capacitor between VPP (Pin 1) and ground (Pin 8) of the socket before inserting part. This will slow the VPP rise time and allow the device to enter programming mode.

B.2.5.2 WHEN READING A BLANK PIC16C55A, PIC16C57C OR PIC16C57, PROGRAM MEMORY VALUES OF 0XBFF ARE REPORTED

The oscillator circuit for these devices is different from that of previous devices and can cause contention during the read operation.

Use a stand-off socket with OSC2 (pin 26) clipped.

B.2.6 LED Indicators Flicker or Do Not Light

This could be the result of the thermal fuse being blown. This may be due to either the wrong part being selected or the device was improperly placed in the ZIFF socket. Remove the device and cycle power on the PICSTART Plus programmer to reset the internal thermal fuse. Make sure the device is aligned Pin 1 to Pin 1 in the PICSTART Plus ZIFF socket.

The LEDs may flicker or fail to light as a result of an Incompatible power supply or power supply polarity is reversed. Make certain the power supply used is the one included with the PICSTART Plus programmer or a compatible one. If the unit still does not turn on, contact Microchip support.

B.2.7 Device Pin Damage

On the smaller device packages (SSOP, PQFP and SOIC) the pins can bend easily and cause problems when programming the devices. Use small needle-nose pliers to straighten the pins and attempt to program the device again.

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B.2.8 Download Not Successful

If there is an interruption to the power, the serial communication or the state of the MPLAB IDE while a firmware download is in progress, the download may fail. Some of the error messages which may be displayed include:

- PICSTART Plus Firmware has been corrupted. You must download a new operating system.
- PICSTART Plus not found. Please verify serial connection and try the current operation again.
- Download Firmware not successful.
- Download Firmware not successful. Number of bytes not echoed properly.

The communication between the MPLAB IDE and the PICSTART Plus begins as soon as the download option is selected. Always make sure that there are no communications problems with the PICSTART Plus before attempting to use the option to download firmware. To ensure this, perform a *Programmer>Enable*. If this is successful without communication errors, the PICSTART Plus is ready for further communication.

Perform the firmware download if needed. When the download completes, Disable, then Enable the programmer so that the change in firmware versions will be fully recognized by the MPLAB IDE. Perform a *Programmer>About* to confirm the version now in use. More details on downloading newer firmware can be found in **Section 5.8.5 "Downloading New Firmware"**.

Note:	An error message will be received if an attempt is made to download onto a PICSTART Plus that contains a PIC17C44.

B.3 ERROR MESSAGES, WARNINGS AND ANNOUNCEMENTS

These are some error messages, warning or announcements you may receive:

- Cannot Transmit/Receive
- Newer Firmware Required
- New Firmware Available
- Download Not Successful
- Could Not Open The Communications Port
- Program Memory Contains Code-Protected Data
- Framing Error
- Parity Error Found In Program Memory
- Send/Receive Errors

B.3.1 Cannot Transmit/Receive

Cannot Transmit: This is the most common error. It indicates that the PC cannot send any information to the programmer.

Cannot Receive: The software is able to send information to the programmer, but the programmer is not responding.

Refer to **Section B.2.1 "Failure to Establish Communication with PICSTART Plus"** and **Section B.2.2 "Advanced Serial Communications Help"**.

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B.3.2 Newer Firmware Required

If a message "This device requires firmware *xx*" is displayed after using the option *Programmer>Enable*, it indicates that the firmware currently in use does not support the selected device. The minimum firmware needed to support the device is stated in the message. The firmware that supports the device will need to be downloaded before the PICSTART Plus an be used. See **Section 5.8.5 "Downloading New Firmware"** for instructions.

B.3.3 New Firmware Available

If a message is displayed announcing that newer firmware is available after using the option *Programmer>Enable*, there is nothing wrong with the PICSTART Plus. The message is just to announce the fact that a newer version firmware is available in this version of the MPLAB IDE. If you plan to use a device whose support is new to the PICSTART Plus, you will want to download the newer firmware. Otherwise, there is no need to download the newer firmware.

B.3.4 Download Not Successful

If there is an interruption to the power, the serial communication or the state of the MPLAB IDE while a firmware download is in progress, the download may fail. Some of the error messages which may be displayed include:

- PICSTART Plus Firmware has been corrupted. You must download a new operating system.
- PICSTART Plus not found. Please verify serial connection and try the current operation again.
- Download Firmware not successful.
- Download Firmware not successful. Number of bytes not echoed properly.

The communication between the MPLAB IDE and the PICSTART Plus begins as soon as the download option is selected. Always make sure that there are no communications problems with the PICSTART Plus before attempting to use the option to download firmware. To ensure this, perform a *Programmer>Enable*. If this is successful without communication errors, the PICSTART Plus is ready for further communication.

Perform the firmware download if needed. When the download completes, Disable, then Enable the programmer so that the change in firmware versions will be fully recognized by the MPLAB IDE. Perform a *Programmer>About* to confirm the version now in use. More details on downloading newer firmware can be found in **Section 5.8.5 "Downloading New Firmware"**.

B.3.5 Could Not Open The Communications Port

If the communications port cannot be opened, it is because either another application has opened the port or the port does not exist. Make sure the port number is valid and that no other application is using it, such as another instance of MPLAB IDE.

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B.3.6 Program Memory Contains Code-Protected Data

When a Read is performed on a device in which an area of its EEPROM or Program memory has been code-protected, a message will be displayed stating that the information may not be valid. A code-protected OTP or EPROM device cannot be erased; Flash devices however, can be erased or over-programmed.

The data in the memory area that have been code protected may be scrambled or show zeroes. The areas of the device that have not been code protected may be available for programming. Some devices require that the entire device be programmed if code protection is detected. Consult the data sheet for the device to determine how code protection is handled, if certain memory areas are exempt, etc.

B.3.7 Framing Error

This error indicates a hardware problem occurred while trying to read from the programmer. It is not a very common error. It usually indicates some sort of problem with the communication hardware on either the PC or the programmer.

B.3.8 Parity Error Found In Program Memory

Several devices have a configuration bit to request the calculation of parity. When the bit is set to “ON,” the contents of the program memory are compared and assigned “even” or “odd” parity. When set to “OFF,” the device does not perform a comparison.

On a blank device, the parity configuration bit is set to “ON” by default. If the device is programmed with the parity configuration bit set to “ON,” any reprogramming of the device may result in a parity error being displayed. This occurs because a mismatch has been detected between the current parity and the parity last programmed. Receiving a parity error, however, does not stop the device from being programmed.

However, if the device is programmed with the parity bit set to “OFF,” no comparison of the program memory contents for parity will take place. The device can be reprogrammed without receiving a message regarding parity.

All OTP devices, including those that have the parity configuration bit, cannot successfully reprogram any bit value of “0” to a “1.” If a device has been programmed with the parity configuration bit set to “OFF,” the parity checking cannot be turned back to “ON.” A blank device will have to be used.

B.3.9 Send/Receive Errors

Send errors can occur because the MPLAB IDE is attempting to communicate with the PICSTART Plus on the designated COM port and not getting a response. This error is usually followed by a “No programmer detected” message. Ensure that the PICSTART Plus power is physically connected and that the serial cable is connected from the workstation to the PICSTART Plus. Make sure the COM port designated in the MPLAB IDE is actually the one use.

A receive error, such as serial time-out scan, occurs while a device is being read or programmed. It can be caused by losing a serial connection in the middle of an operation or the device not being properly aligned in the PICSTART Plus ZIFF socket. Though the problem is not common, the problem has been seen more often on Windows ME and 98/SE operating systems. If the problem cannot be resolved by programming the device using a smaller program memory range or specific memory areas, another Windows operating system may have to be used.

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B.4 LIMITATIONS

- General Limitations
- Device-Specific Limitations

B.4.1 General Limitations

- PICSTART Plus development programmer enables you to program PICmicro microcontroller devices. Adapters can be purchased for certain package types. Consult the Microchip web site for availability. View the `readme.pls` file for a list of currently supported devices.
- The PICSTART Plus programmer is designed for use in firmware development and is not intended for production use.
- PICSTART Plus does not support ICSP.
- For all memory except configuration bits (that are not code-protected), you may program from 1 to 0, but not from 0 to 1, i.e., you must erase and then program.

B.4.2 Device-Specific Limitations

In addition to the general limitations listed above, some PICmicro MCUs may have device-specific limitations.

- **PICSTART Plus Limitations for PIC16F87X/87XA**

  First program memory location (address 0x0000) must be a NOP instruction.
- **PICSTART Plus Limitations for PIC18F2331/2431**

  All power supply (V_{DD} and AV_{DD}) and ground (V_{SS} and AV_{SS}) pins must be used in order for these devices to program. PICSTART Plus will handle V_{DD}, V_{SS} and AV_{SS} properly, but you must place a 1kOhm resistor between Pin 7 (AV_{DD}) and Pin 11 in the socket with the device for proper operation. There are other devices that may require the use of all power supply and ground pins. Consult the data sheet if an unexplained programming problem occurs, such as inconsistent programming.
- **Boundary Constraints**

  Several devices have constraints on how ranges of program memory can be specified for programming. The PICSTART Plus software check the Start and End addressed entered in the Memory Range text box in the Settings dialog. A message will be displayed if the entry is improper for the device.

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Index

Symbols

_ _CONFIG 39

B

Blank Check All 40
Blank Check OTP 40

C

Calibration Memory
    Programming 42, 47
Communications Port 10, 13
Configuration Bits
    Dialog 38
    Program/Verify 42, 47
Customer Notification Service 4
Customer Support 4

D

Document Conventions 2

E

EEPROM
    Programming Data 42, 47
EPROM 40

F

File Formats 38
Flash 40

H

Hardware Installation 10
Hex File
    Loading into Program Memory 37

I

ID Locations
    Program Verify 42, 47
INHX32 38
Installation
    Hardware 10
    MPLAB Software 9
Internet Address 3

J

JW package 40

L

Loading a Hex File 37

M

Microchip Web Site 3
MPASM 7, 38
MPLAB 7
MPLAB CXX 7
MPLAB Development Tools 7
MPLAB Editor 7
MPLAB ICE 7
MPLAB IDE
    Installing 9
    Starting 11
MPLAB Projects 7
MPLAB SIM 7
MPLIB 7
MPLINK 7

O

Operating System Upgrade 62
OTP
    Blank Check 40

P

PICSTART Plus 7
PICSTART Plus Toolbar 49
Power Supply 10
Program Memory 35
    Importing a Hex File 37
Program Memory Window 55
Programming
    Calibration Memory 42, 47
    EEPROM Data 42, 47
    Procedure 31

R

Reading
    Device 46
RS-232 ..... 10, 13

S

Serial Port 10, 13
Software Installation, MPLAB 9
System Requirements, Host Computer 9

W

Windowed Device 45
WWW Address 3

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Fax: 91-80-2229-0062

India - New Delhi
Tel: 91-11-5160-8632
Fax: 91-11-5160-8632

Japan - Kanagawa
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Fax: 81-45-471-6122

Korea - Seoul
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Fax: 82-2-558-5932 or
82-2-558-5934

Singapore
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Fax: 65-6334-8850

Taiwan - Kaohsiung
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Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Taiwan - Hsinchu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

EUROPE

Austria - Weis
Tel: 43-7242-2244-399
Fax: 43-7242-2244-393

Denmark - Ballerup
Tel: 45-4420-9895
Fax: 45-4420-9910

France - Massy
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Ismaning
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

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